COST OF ELECTRIC SERVICE FOR AN OPERATING UTILITY

A Thesis

Submitted for the Degree

of

ELECTRICAL ENGINEER

By

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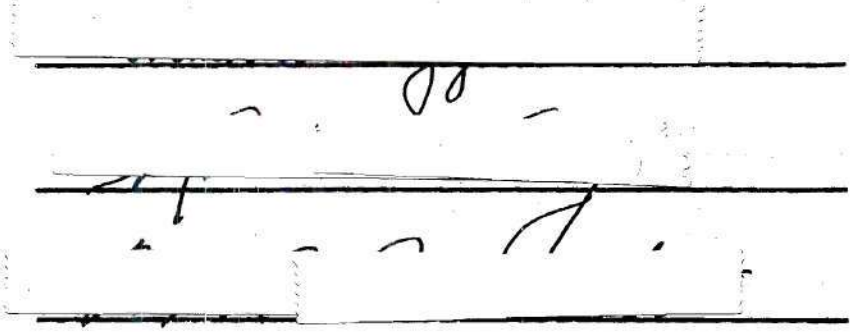

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PREFACE

The author has had the direct responsibility of actually supervising and preparing several studies of the "Cost of Electric Service" for an operating utility, these studies having been the first ever undertaken by this particular company. Though a considerable amount of material has been published upon the subject of electric service costs (see Bibliography), no literature seems to be available which explains the actual methods and data involved in the solution of this problem or the results of such a study.

The utility industry, vested as it is, with more than ordinary public interest is finding it of increasing importance to obtain definite information as to the costs of supplying the various classes of service. Operating utilities, with the assurance of reasonable accuracy in making such analyses, should find the results of this type of study useful as:

A valuable measure of the results of existing rate practices.

A pattern for the establishment of simplified and well balanced rate schedules.

A guide for the determination of wise promotional activities.

A convenient source of data for special studies, of either total cost or out-of-pocket cost, involving particular industries or customers.

A means of securing a better coordinated control over both the construction and operating budgets.

Providing a better measure of what capital additions may be justified for new business or to reduce operating costs.

A source of authentic material for publicity purposes, permitting a determination of the various percentages of the several elements in the cost of service, thus possibly promoting a better understanding among the public of the utility business.

Assisting in the determination of a retirement and maintenance policy.

The primary purpose of the work was to determine costs for the various classes of service. As there is no known method of storing electrical energy economically, electricity must be produced at the moment it is demanded by the customer. Electricity is not a commodity at all but is a form of energy, and it follows, therefore, that the customary methods of cost analysis employed in the commerce of the world are not applicable as a guide for the electric utility industry. The sale of electricity is more in the nature of the rental of facilities and the relation between the producer and consumer are in many respects similar to those of landlord and tenant. In determining the scope of the study, careful consideration was given to the distinctive type of loads, competitive factors, the major differences in the cost to serve, the manner in which electric service is rendered and to the rate schedules in effect. The separate classes of service segregated were: (1) Residential, (2) Small Light and Power, (3) Large Light and Power, (4) Miscellaneous Municipal, (5) Street Lighting, (6) Rural, (7) Oilfield, (8) Refineries, (9) Street Railway, (10) Resale, (11) Cotton Gins, (12) Grain and Milling, (13) Coalfield, (14) Eastern District, (15) Western District.

Since much of the physical plant is used in common by

several or all classes of service, the most important element in the work was the allocation of the investment and operating costs to each class of service. It must be appreciated that a work of this nature offers no opportunity for the attainment of an exact mathematical solution, in fact, meticulous exactness is disclaimed. It is rather a very practical engineering-economic study requiring for its solution an extensive knowledge of the electric utility business, and more especially of every major function of the particular company being studied, the physical, operating and economic conditions of the property, and it is only by an engineering approach based on facts and a considerable element of judgment, and with opinion allocations reduced to a minimum, that a solution is at all possible.

It must be appreciated that it is not only impracticable but virtually impossible to present in a work of this nature all of the fundamental data upon which the analyses are based. Many of the cost records consist of original construction and valuation reports, copies of which are available only in the vault of the company. It would be no exaggeration to say that these voluminous cost and accounting records, the engineering studies, the load charts and meter records, together with the working papers, would constitute virtually a ton of material. While it is not intended that each detail be presented in the work, the explanations are sufficiently comprehensive to illustrate the methods.

It must be recognized that any rational interpretation of the results of this study in comparing costs between companies or between different parts of the same company and

classes of service must recognize the differences in the source of power, voltages, customer densities, system design, competitive service, load characteristics, economic conditions affecting particular classes of business, and the general physical, economic and political structure of the territory served.

The system for which costs are studied is a far-flung power system serving 237 towns located in 47 counties of two adjacent states. The development of this power system was characterized by an unusual rate of expansion and construction during the years 1921-1929, inclusive, when construction costs were unusually high. Practically the entire territory served is supplied with exceptionally low cost natural gas, by competitive concerns, which is available to both industrial and domestic customers. This severe competition for business contributes to a comparatively low customer usage of electric service. For instance, on a purely competitive price basis, electrical energy would have to be sold for less than 2.5 mills per kwhr to the domestic consumers for cooking purposes. The company studied supplies power service to the petroleum industry including all phases of the business such as drilling, production, pipe lines and refineries, which are located in 20 different oilfields, including two of the major producing areas of the world. The principal territory served is located in the great plain regions of the country characterized by low rainfall and unusually low stream flow during prolonged periods of drought. These climatic conditions necessitate the provision of expensive means of supplying condensing water for the major steam generating plants and results inherently in

plant investment costs that are higher than can be attained under more favorable conditions. Certain areas of the transmission and distribution system are subject to unusually severe "glaze storms" and with annual temperature extremes of -30 to 118 degrees and the entire area subject to infestation of the poles by termites, all of which entail high operating and maintenance costs.

The author is indebted to the executives of the company by whom he is employed for having permitted the use of much confidential data which have been accumulated for specific purposes. Obviously, had not the services of a large organization been available, it would have been wholly impracticable to obtain the voluminous test load characteristics of the several classes of service, or to secure the detail analysis of customer revenue and energy sales records in order to permit a proper classification of the customers into correct groupings.

GENERAL METHOD OF ANALYSIS

Since much of the physical plant is used in common by all, or several classes of service, the most important element in the work was the allocation of the investment and operating costs to each class of service. Such a joint use of facilities is not only necessary, but very desirable as the diversity in class demands reduces the costs to each class of service. The greater this common usage, the lower the unit costs can be, but the more difficult the problem of allocation.

Investment, expense, and customer records are available by the standard classified accounts for public utilities. The problem in this work consisted essentially of translating these standard classified investment and expense records to a form showing these items by classes of customer, and with a knowledge of the revenue from each class of service it permitted the determination of the profit earned under the class rate schedules. With certain omissions, the total book costs, both investment and expense, have been adhered to; the book figures having been translated into a form showing this information by classes of service, thus giving for the particular year and prevailing conditions the rate of return earned on each class of service. The customers supplied from the power system and the kilowatt hour sales to these customers have been segregated by classes of service to correspond with the segregation of revenue, investment, and expense data.

The principal advantage of this general method of cost analysis is that the total investment and expense corresponds

to the classified accounts; and the results are based on costs actually incurred rather than attempting to build costs on synthesis. Since there is a definite responsibility to the security holders for the entire investment and expense, rate schedules should be founded upon cost as one element in their structure. An individual engineering cost study made for each class of service very likely would yield a total investment and cost below the standard accounts due, among other factors, to the expensive construction attendant upon rapid system expansion and to differences in equipment costs at present and in the past. An individual engineering cost analysis would never yield a total investment equivalent to the total book values due, among other factors, to the expensive construction attendant upon rapid system expansion and to differences in equipment costs at present and in the past. In the first place an actual physical inventory of the entire system with its attendant expense would be necessary. In arriving at the historical costs of the investment facilities it must be appreciated that the property has not been built as a unit, but by a series of progressive extensions. For instance, the resulting investment in a large substation is much greater, when it has been constructed over a period of years by a series of additions, than if it had been constructed at one time as a complete unit; and thus it is for practically all portions of the physical property. Even were the memory of man thoroughly reliable, many of those who have constructed the property are no longer here and we must therefore perforce resort to the accounting records for an accurate record of the value of the physical property and the historical investment.

BASIS OF COST ALLOCATIONS

The analyses and distributions of investment and expenses to classes of service have, as far as practicable, been based upon factors which reflect the nature of the costs to be distributed and the manner in which they are incurred.

Cost of electric service depends primarily upon -

(a) number of customers served,

(b) maximum demand, and

(c) energy delivered

These are the three primary components generally recognized in modern rate structures, and are, to a large extent, based upon statistics which are, or can be, collected in the course of carrying on the business and, therefore, form the fundamental basis of much of the cost allocation. In some instances, costs are directly assignable as specific burdens of a particular class of service, and in other cases, detailed analyses justified assignments to a specific class.

Customer costs include that portion which varies principally with the number of customers served, such as a large portion of the investment in meters and services, and expense of their maintenance, consumers installation expense, commercial expenses and a portion of new business expenses.

The demand costs include investment in generating plants, transmission lines, substations, distribution lines and transformers, and the expense of maintenance and operation of these facilities, except for a portion of the distribution costs which may be assigned on a customer basis, and for that portion of the production costs which varies with the energy output.

The energy costs include fuel at the generating plants and that portion of maintenance and labor which varies with the output and the variable portion of cost of energy purchased from interconnected companies.

After making a division of investment and expenses into the three fundamental groups shown above, these costs have been assigned to the various rate classes on a customer, demand or energy basis or by special analyses where direct assignments could be made.

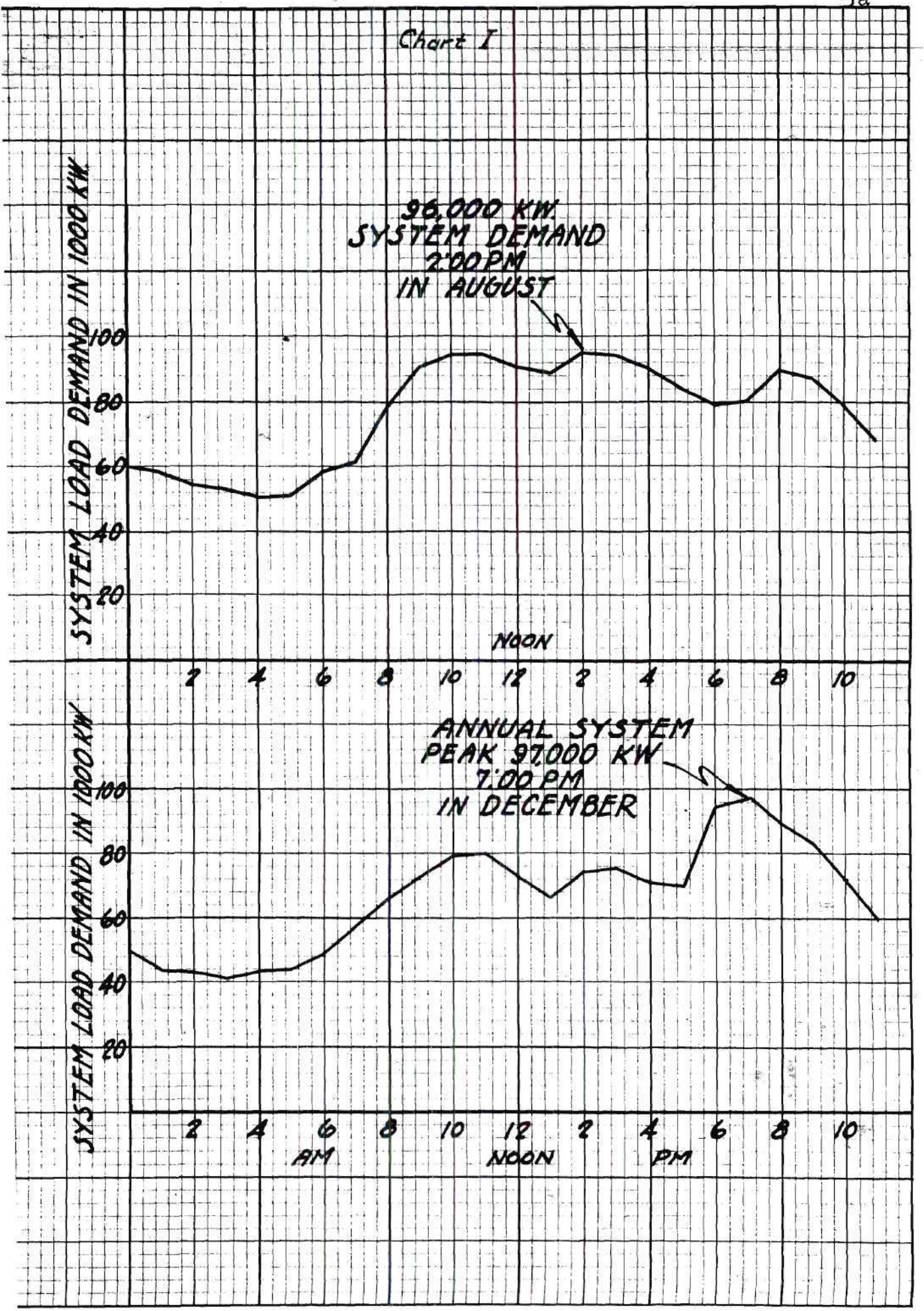
Among those who are thoroughly acquainted with the problem it is the accepted viewpoint that, of the many variables affecting distribution costs, the customer density is of most importance. This is true because customer density, more than any other factor, determines the amount of distribution investment required and the annual fixed and operating charges on such investment are a major portion of the total distribution cost. Customer costs, dependent as they are upon the number of customers served, were distributed to each class of service using the particular facilities on the basis of "the ratio of the number of customers in the particular class of service to the sum of the number of all customers."

In the assignment of demand costs, the non-coincident annual peak demand on the power system of the several classes of service has been used. Under this method of allocation, each class of service shares in the benefits of diversity between the classes. Diversity is not a characteristic of a single class of service but rather a mutual relationship existing between two or more classes of service. All demand allocations are based on the maximum demands of the classes of

service, regardless of the time of occurrence in the year, and are apportioned in all cases, on the basis of "the ratio of the annual maximum demand of the particular class to the sum of the maximum demands of all classes." This method recognizes not only the magnitude of the load demand of each class of service, but also the relation of each load to the other classes of service and the system load. The use of this method of allocation is in accord with the concept that cost is a stable property of the service and not susceptible to violent fluctuations on account of conditions external to the class of service or the control of the company.

The use of the annual non-coincident peak demand basis of assigning the demand costs is especially applicable for the particular system being studied because of the nature of the loads served and the resulting system load curve. Reference to chart 1 showed that the winter system peak, when the lighting load was large was only slightly more than the afternoon demand in August, when the industrial load was predominant. A study of the power system loads for several years in the past has revealed that in some years the annual peak demand occurred in the morning or afternoon, when the industrial and commercial loads predominated, while in other years the power system peak demand occurred in the evening when the lighting load was large. The use of the "peak responsibility" basis of assigning demand costs obviously would result in violent fluctuations in the magnitude of these costs assigned to the several classes of service in making cost analyses of this nature from year to year. The use of the annual non-coincident peak basis of assigning demand costs results, however, in reasonably uniform

Chart I


96,000 KW.
SYSTEM DEMAND
2:00 PM
IN AUGUST
SYSTEM LOAD DEMAND IN 1000 KW.
100
80
60
40
20
NOON
2
4
6
8
10
12
2
4
6
8
10
ANNUAL SYSTEM
PEAK 97,000 KW
7:00 PM
IN DECEMBER
SYSTEM LOAD DEMAND IN 1000 KW.
100
80
60
40
20
2
4
6
8
10
12
2
4
6
8
10
AM
NOON
PM

results from year to year, in studies of this nature.

The demands of each class of service on the power system or at the transmission substation have been used as a basis for the allocations. Theoretically these demands should be determined on each element of the distribution system also such as at the meter, the distribution substation and at the power plants. The relative demands of each class of service having been determined at the transmission substations, obviously the relative magnitude of these demands would be virtually the same at the power plants and it is therefore not necessary to calculate these values on each element of the system.

Energy costs dependent as they are upon the number of kilowatthours generated are distributed to each class of service on the basis of "the ratio of the annual kwhrs generated for the particular class to the total kwhrs generated for all classes served from the power system."

LOAD CHARACTERISTICS

Since the major portion of cost for electric service depends upon the diversified demands of the various classes, the determination of class loads was one of the most important, and likewise one of the most difficult parts of the work. Therefore, this phase of the work was given the utmost care to insure the greatest degree of accuracy possible.

From graphic meters, permanently installed on the proper circuits, it has been possible to determine with a reasonable degree of accuracy, the kilowatt demands of the various classes of service. Test meters, of the graphic integrating type, were installed on carefully selected circuits, serving predominantly certain classes of customers, in order to determine their load characteristics. The consumption from these circuits was determined from the metered sales.

Fifteen minute interval demand charts were available for a large percentage of the industrial classes of service. The simultaneous demand was determined and thus the annual load factor established which was applied to the kwhr sales of each particular class of business. In some cases demand charts from individual customers were used and in other instances charts from relatively large substations supplying a large load of one particular class of service was used. The annual load factors were in this manner established for the Resale, Grain and Milling, Oilfields, Large Light and Power, Miscellaneous Municipal, Refineries, Rural, Coalfields, Street Railway, and Cotton Gin business. The miscellaneous municipal class of service is composed of water pumping as well as the

lighting of public buildings so that it was necessary to determine the relative magnitude of these two types of load in each rate class in order to arrive at the composite load characteristic.

Some appreciation of the comprehensiveness of these test characteristics may be gained from the fact that of the total customers in each class of service actual demands were measured and studied; for 78% of the total grain and milling business; for 27% of the total oilfield business; for 51% of the total refinery business and corresponding proportions of other classes of service.

By securing the number and size of the street lights in the various towns, by rate classes, it was possible to establish the demand at the substation after having made an adjustment for line loss.

The load characteristics of the Residential and of the Small Light and Power classes of service were determined by use of the attached charts II & III, which give the diversified characteristics of large groups of customers. These curve sheets give the demands measured out on the primary feeder circuits so that it was necessary to add the losses to determine the demands at the substations. Thus, knowing the average sales per customer in each rate class, it was possible to determine the entire class of service demand at the substation by the use of these curves. Chart IV serves to illustrate the method used to obtain these test load characteristics.

The information as to the characteristics of the residential and the small light and power customers is quite com-

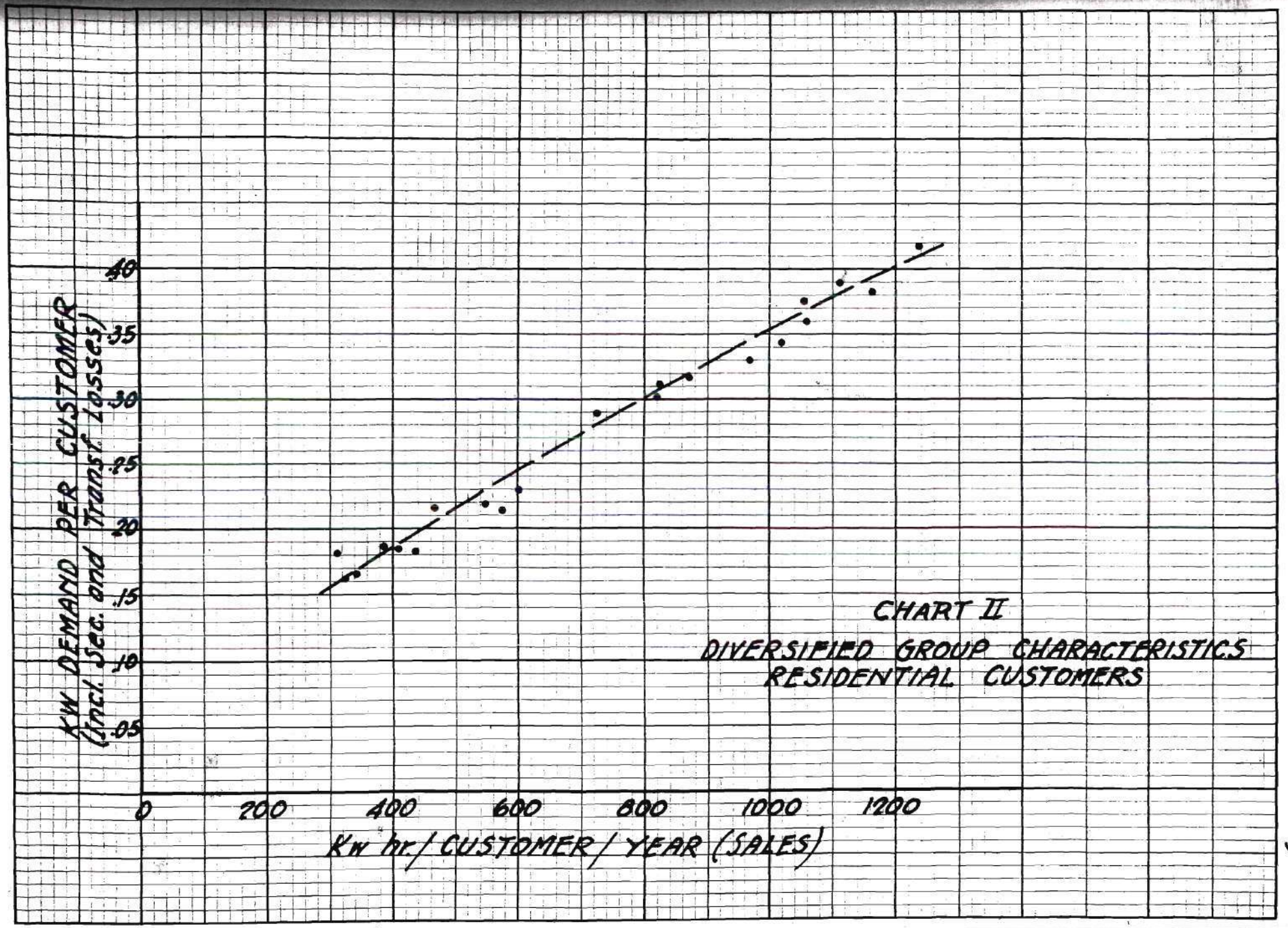


CHART II

DIVERSIFIED GROUP CHARACTERISTICS
RESIDENTIAL CUSTOMERS

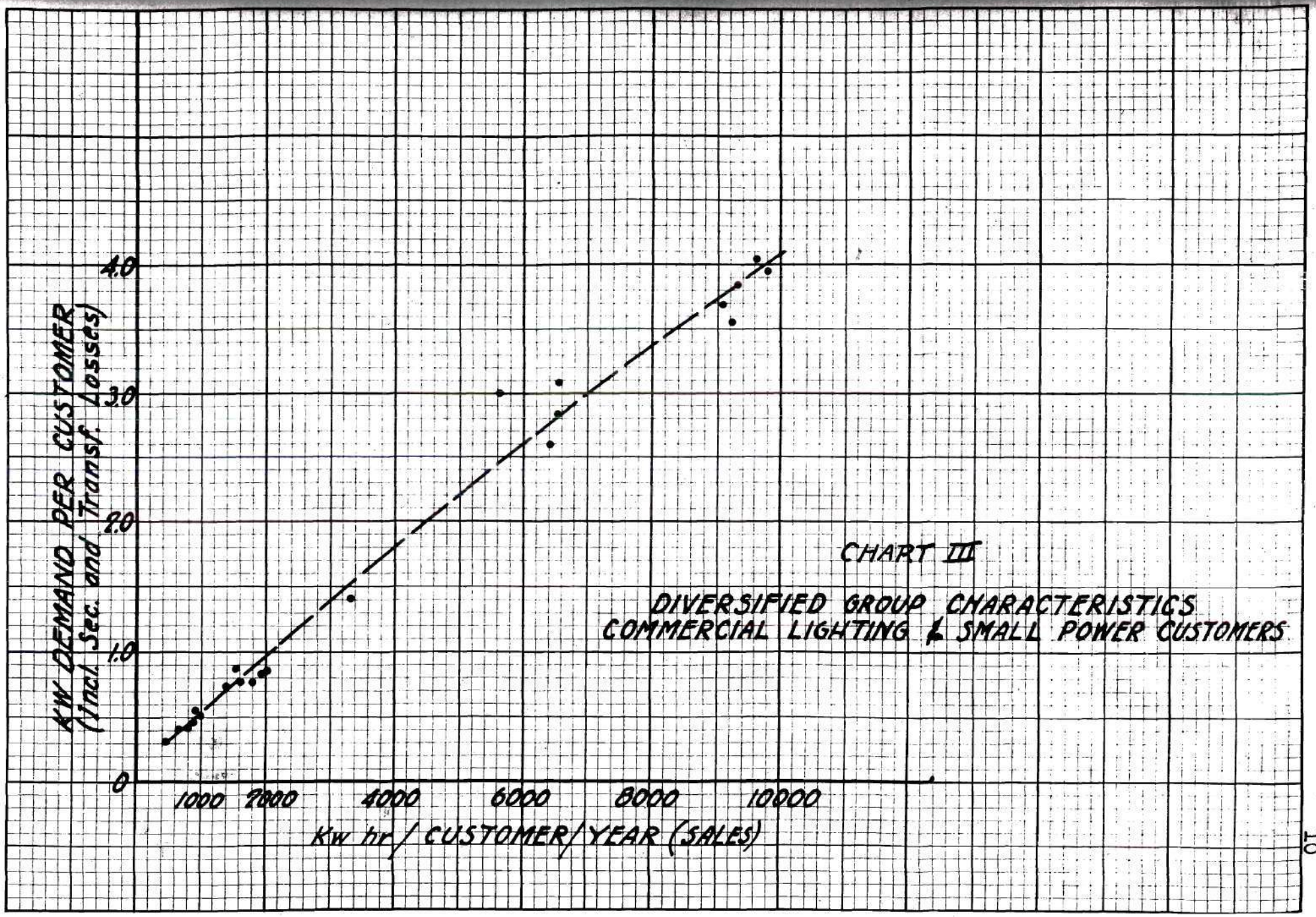
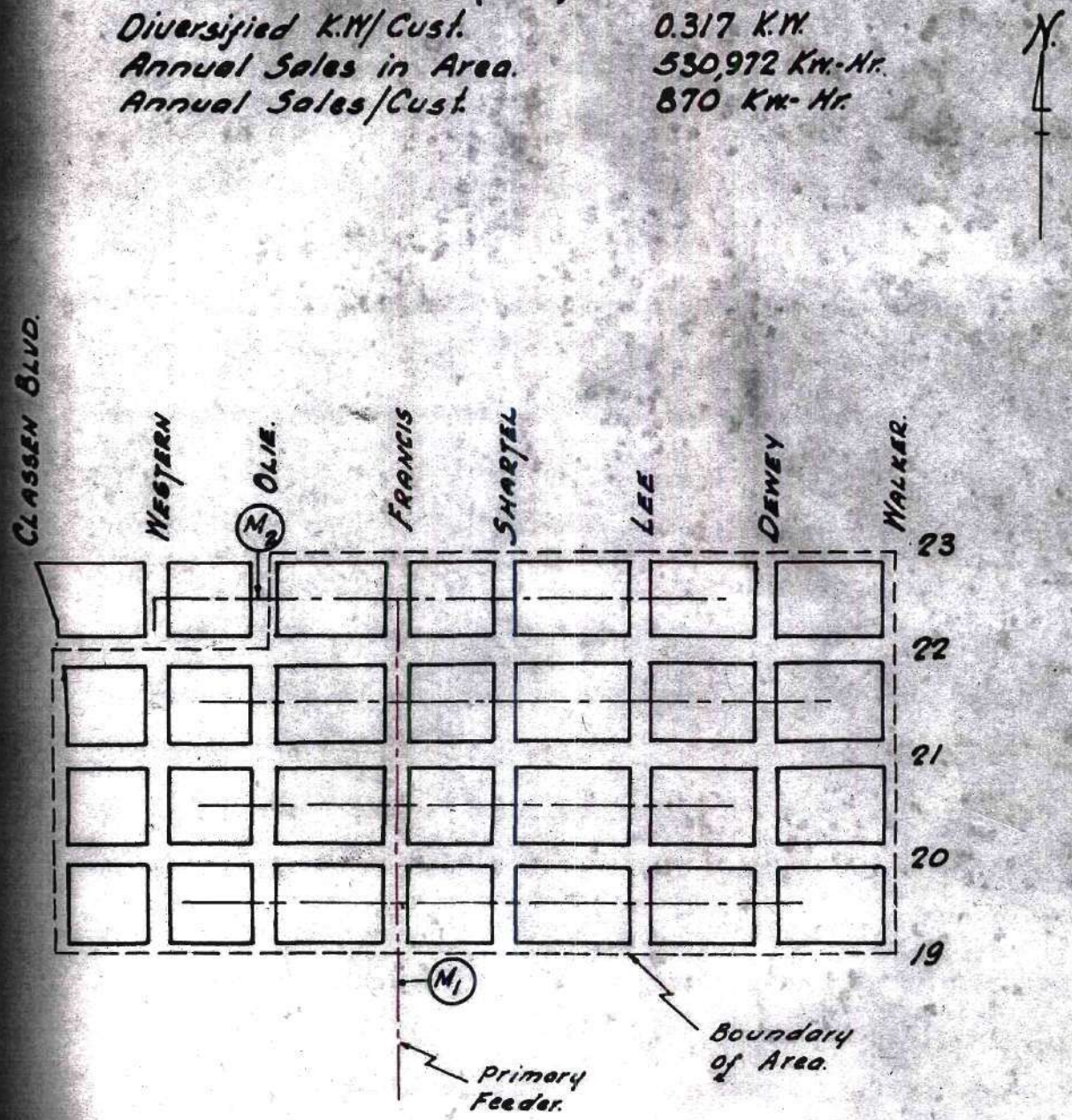


CHART III

DIVERSIFIED GROUP CHARACTERISTICS
COMMERCIAL LIGHTING & SMALL POWER CUSTOMERS

No. of Customers in Area.	610
Annual Max. Demand (Total).	193.4 K.W.
Diversified K.W/Cust.	0.317 K.W.
Annual Sales in Area.	530,972 Kw.-Hr.
Annual Sales/Cust.	870 Kw.-Hr.



NOTE:-
To obtain Demand of the Area Subtract M2 from M1. M1 & M2 are Kw.-Hr. Meters and 15 Min. intergrating Demand type Meters.

CHART IV

RESIDENTIAL LOAD CHARACTERISTICS.

prehensive in that the tests were taken over a period of four years totaling over 12,000 residential customer-years and over 1,600 small light and power customer-years; thus including in the scope of these tests a considerable portion of the total customers in these classes of service. The test results when plotted on the curves are remarkably consistent and the comprehensiveness of the tests renders these results undeniably reliable. It must be appreciated that these results portray the diversified characteristics of large groups of customers and not the characteristics of individual customers. For other utility systems, where the utilization appliances, and the customer saturation of these appliances, are different, these load characteristics of course would not apply. And it must also be appreciated that while the characteristics of these two classes of service are directly and materially affected by the types of appliances in prevalent usage on the system, these types of appliances are in turn governed to a large extent by the competitive forms of energy which are sold in competition with the electrical energy.

In comparing the characteristics of the residential with the small light and power customers a particularly significant fact is evident; for instance, at an average annual consumption of 1000 kwhr/cust/yr the residential demand is 0.35 kw/cust while the small light and power demand is 0.55 kw/cust. A more detailed examination of the characteristics of the small light and power customers reveals a pronounced peak every Saturday night which is considerably greater than the demand established by these same customers on other days or nights of the week. This pronounced Saturday night peak is

evidently caused by the regular operating schedule of commercial establishments and this feature precludes the great diversity for this class of service, which is a characteristic of the residential class of service.

In classes of service composed of a vast group of relatively small customers the operating characteristics of a few customers will have little effect on the total load so that comparatively uniform results can be expected from year to year in studies of this nature.

The inter-class diversity or the ratio of the sum of the diversified demands of the various classes of service and principal industries to the maximum load demand on the power system, was 1.43 for the year.

Some of the metered demands for determination of the customer load characteristics could not be obtained at the transmission substations as many of these meters were actually on the premises of large customers thus involving a certain amount of primary feeder circuit between the location of the test meter and the transmission substation. Under each typical condition of feeder circuit layout thus entailed, the losses were calculated and added to the meter readings in order to determine the demand at the transmission substation. Upon examination of the characteristic curves of the residential and the small light and power customers, it will be observed that the exact values of Kw demand shown on the curve were not used but proper additions were made to these values for the feeder loss between the location of metering and the transmission substation.

Obviously it is not only impracticable, but virtual-

ly impossible to present in this report all the detail data supporting these summarized load characteristics of the various classes of service. For instance, the supporting data for the residential load characteristic curve alone entailed the detail study and tabulation of over 5400 demand charts, each of a seven day period. Many of the demand charts used for the determination of the diversified characteristics of the various industrial classes of service are also utilized for billing purposes and are therefore kept in permanent files in the various divisional office headquarters; these charts are sent in for analysis and after being studied and tabulated, are returned to the divisional files.

Knowing the total annual kwhr sales of each particular class of service and applying the results of the comprehensive tests on groups of customers to the total sales, it was thus possible, with a reasonable degree of accuracy, to determine the annual peak diversified demand of each class of service. Having thus determined the annual peak diversified demand of each class of service, that portion of investment and expense which is a function of demand was then allocated to the several classes of service according to their proportionate responsibility for it. See Appendix for details of load determination.

Due to the relatively high saturation of electric refrigerators among the residential and small light and power customers tests have revealed that the power factor of this class of service at the time of the peak demand is not materially different from the various industrial classes of service. The total power system load power factor at the

time of the annual peak load demand is approximately 80% and as most of the electrical equipment is rated at this value of power factor it is not believed to yield far from accurate results to neglect the power factor for the several classes of service. It is also of importance that there are no inexpensive and accurate recording power factor meters available with which these values might be accurately established.

ELECTRICAL LOSSES

Records were available of the annual kilowatt hour transmission loss, and the amount of distribution losses in each division and town. With a knowledge of the installed transformer capacity, both transmission and distribution, the total annual losses were segregated between iron loss and copper losses. The iron losses being constant were therefore assigned to the several classes of service on a demand basis. The copper losses were assigned to the several classes of service on a load factor basis.

Theoretical studies indicated that the copper losses should be assigned to each class of service in proportion to the equivalent hours of the load curve; the equivalent hours being defined as the average number of hours which it would be necessary for the peak load to continue in order to give the same total energy loss as that actually given by the variable load. A thorough exploration of this indicated, however, that within practical limits it is sufficiently accurate to assign copper losses on a load factor basis as above described.

ASSIGNMENT OF COSTS

CAPITAL INVESTMENT

The Capital Investment used in this study was taken from the fixed capital or property record of the Company, as set up under the standard classification of accounts. This record did not give a classification of the property by the accounts exactly as defined and used in this study. As one instance, the classified account termed "transmission substations" includes both transmission substations and a large portion of the local substation investment. It has been necessary in this study to make a detailed analysis of each substation carried in this account and to divide it correctly between transmission and local substations. This information has been supplemented by a record of the costs of materials and supplies and the transportation reserve. The entire capital investment was reconciled with the annual report.

The distribution investment, by standard accounts, is carried in the fixed capital record for each city, town, principal industry, rural and the Western District systems separately, with a few exceptions. For instance the distribution investment is segregated for the oilfields and the rural service and is largely segregated for the coalfields, the refineries, the resale service, grain and milling business, and the street lighting service. An actual inventory was available of the special facilities for supply of the cotton gins. The distribution investment by standard accounts was combined for the towns, by rate classes, and

principal industries, the totals of which are shown on the system investment sheet.

A considerable portion of the industrial classes of service studied are located within the confines of towns and are supplied from the local distribution substations. The proportion of each class of service within the various rate class towns was determined and by special analyses of cost and valuation records the proper investment was assigned to these classes of service together with a proportionate amount of expenses.

The substation and distribution investment for the Railway Company has been determined by special analysis. Several of the major railway substations were segregated in the account records, and estimates were made of the investment in other substations so that these were directly assigned to this class.

Engineering estimates were made to determine for each rate class, the investment per light for the street lights; thus, knowing the number of street lights in each town, the total investment used exclusively to serve street lights was obtained.

POWER SYSTEM

Generating Plants:

The peak demand on the interconnected power system was 97,050 Kw for the year being studied. The total capacity in generating facilities was 167,000 Kw and the largest individual generating unit was of 30,000 Kw capacity. Operating maintenance schedules demand that a reserve capacity, at least equal to the capacity of the largest single unit on the

system, shall at all times be maintained and due to the necessity for the protection of service to the more remote towns, some of the smaller generating plants serve simply as standby for emergencies. Comprehensive studies have indicated that when the total load has reached a value of about 135,000 Kw it will become imperative to have completed the construction of an additional generating unit which will obviously be of such a size that some time will elapse before the capacity is absorbed - in other words, additional capacity can not be added in small increments exactly corresponding to load growth and it is therefore inevitable that an apparent excess generating capacity will always exist.

The investment in generating plants was assigned to the several classes of service on the basis of the non-coincident peak demand of each class.

The Noble St equipment has been omitted in this study because it is obsolete and no longer operated. The building, however, is used for shop purposes and the investment is therefore included.

TRANSMISSION LINES:

The investment in transmission lines used jointly by all classes was allocated to the industries and to the classes of service on the basis of the non-coincident demands.

No town, industry or class of service was penalized for its location on the transmission system. The entire investment in interconnected transmission facilities was allocated to the classes of service supplied therefrom on the basis of their responsibility for it as determined by the magnitude of the peak Kw demand .

The investment in lines used only by a particular industry or by a class of service was assigned to the particular class using the lines, and is shown under distribution lines for that particular class.

TRANSMISSION SUBSTATIONS:

The investment in transmission substations used jointly by all classes is allocated to the industries and to the classes of service on the basis of the non-coincident demands.

In the standard classified accounting records there are 54 separate substations, the capital cost of which has been segregated between transmission and distribution investment. The original segregation of the investment having been made years ago. It was known that capital additions made in these substations, since the original study, were not always properly classified between the transmission and distribution accounts. A detail study was thus undertaken, of original cost reports and valuation records with subsequent additions, in order to properly classify the investment in these substations in accord with present usage as to transmission or distribution.

The cost and valuation records are not only voluminous but in many cases only the one original copy is available in the vault and it is therefore not only impracticable but virtually impossible to present in this report all of the supporting material. Of a total capital investment in these 54 substations of $4,110,196 the accounting records showed $2,166,658 in transmission and $1,943,538 in distribution, while after the detail study and reclassification there was $3,012,487 in transmission and $1,097,709 in the distribution

investment. The relative importance of the necessity for a laborious study of this nature will be appreciated when it is realized that as a result of this analysis a total of $728,397 was transferred from the distribution substation account of Class II towns to the transmission substation account.

The investment in substations used only by a particular industry or by a class of service was assigned to the particular class using the substations and is shown under the distribution substation account.

DISTRIBUTION SUBSTATIONS:

The investment in distribution substations has been assigned to the classes of service on the basis of the non-coincident demands.

POLES AND CONDUCTORS:

The street lighting class was assigned the pole and conductor investment used exclusively for street lighting. There are many poles having other circuits as well as the street light circuit but in these cases there has been no charge for the cost of the joint use pole made to the street lighting investment. The street lighting business is a public service for the benefit of a community as a whole and it is believed that where poles are installed for other circuits no portion of the pole investment need be charged to the street lighting service. Obviously, had any portion of the investment in the poles, occupied jointly with other circuits, been assigned to the street lighting service, the rate of return would have been even lower than this analysis has indicated.

The customer portion of the distribution pole and conductor investment was determined by an engineering estimate.

In order to determine the customer component of poles and lines, an engineering cost estimate based on historical unit costs, was made of a hypothetical distribution system sufficient in extent to provide a two wire connection to each customer; this hypothetical system to consist of minimum size poles, one cross arm with two pins and insulators, and strung with No. 6 conductors. Such a hypothetical system provides only a customer connection with no capacity to provide for demand and is thus termed the customer portion of the total poles and conductor investment, and obviously represents practically the investment in secondary distribution facilities. It was assumed that all pole and conductor investment costs above the cost of this hypothetical system and the street lighting system represents the demand portion of the pole and conductor investment. On the investment allocation sheets this demand portion of poles and lines investment is referred to as "primary."

The distribution atlas record maps were scaled for certain representative towns in each rate class in order to determine the unit customer investment values with the following results:

Rate Class	Total Number of Customers	Unit Invest per Customer
I	44,151	$24.44
II	44,633	39.10
III	14,485	46.40
IV	9,862	92.00

These unit cost values are governed by a number of variable factors the most important of which are the density of customers in the towns and the prevailing prices at the time the distri-

bution facilities were constructed. It is a fact that much of the distribution construction in Class IV towns was installed at a time when prices were unusually and excessively high and too the density of customers in these towns is very low.

Certain classes of customers are not supplied by all portions of the distribution system; for instance, in Rate Class I the industrial customers are not supplied from the secondary distribution system. For the particular conditions of the system being studied the determination of the customer portion of distribution lines investment and the assignment of a proportionate amount to each class of customers has avoided charging a disproportionate amount of this investment against any one class of service. In Class I towns there is a considerable investment in underground facilities which has been combined with the investment in the overhead facilities. As a portion of all classes of service in Rate Class I towns are supplied from the underground facilities and as the investment per kw of load demand is comparable with that of the overhead system this combination of these distribution investments is fully justified.

The demand portion of the pole and conductor investment was allocated to the classes of service supplied by the facility on the basis of the non-coincident demand of the classes.

DISTRIBUTION TRANSFORMERS AND DEVICES:

The customer portion of investment in distribution transformers and devices was determined by estimating the installed cost of a minimum sized (1½ kva) transformer on historical unit costs. This unit value multiplied by the total

number of installed distribution transformers gave the total customer portion of investment in this facility. The customer portion of investment in distribution transformers and devices was allocated to the classes of service supplied by this facility on the basis of the proportionate number of customers in each class.

The remainder, or demand portion, of the investment in distribution transformers and devices was allocated to the classes of service supplied by this facility on the basis of the non-coincidental demand of the classes. It is believed that this method of allocation gives due consideration to the fact that large customers require larger transformers than do the smaller customers.

METERS:

The meter and service investment for each class of service was obtained by estimating the cost of a typical installation. An analysis of all available customer demand billings made it possible to properly weigh the meter and service investment for the Large Light and Power Class of service according to the size of the installation. For instance, of the Small Light and Power Class of service, all load demands were below 10 kw. Of the Large Light and Power Class of service the analysis revealed the following distribution of the customers as to size.

Rate Class	Per cent of Customers of each load range		
	10-40 kw	40-100 kw	100 kw and above
I	39.2	36.6	24.2
II	60.9	26.1	13.
III	47.	29.4	23.6
IV	18.2	45.4	36.4

Knowing the number of and demand of the customers and applying historical unit costs for the values of the meter investment the total investment for the class of service was thus determined. The sum of the meter investments for each class of service in each rate class, estimated in this manner, checked with a remarkable degree of exactness the total book values as shown in the classified accounts.

Tabulated below are the estimated meter investment values together with the actual values in the classified accounts.

Meter Investment

Rate Class	I	II	III	IV
Classified Accounts	$747,394	$794,148	$272,031	$190,931
Estimated Values	745,390	789,700	275,959	186,998

Only in the case of Rate Class IV does the variation between estimated and actual values amount to as much as 2 per cent.

SERVICES:

Estimates were made of the unit installed cost of services used by representative customers of the various classes of service. These unit values multiplied by the number of customers in each class of service, and with certain adjustments made to tie in with the total investment record, gave the total investment in services for each class.

Tabulated below are the estimated values and the actual values in the classified accounts.

Service Investment

Rate Class	I	II	III	IV
Classified Accounts	$728,396	$728,579	$256,460	$160,851
Estimated Values	729,800	722,400	237,000	158,800

Only in the case of Class III does the variation between actual and estimated values of service investment exceed 1 per cent. No explicit reason could be determined for the difference of 8 per cent in Class III. An adjustment of this amount was therefore arbitrarily made in the service investment value for each class of service in Class III in order to reconcile the total with the classified accounts.

GENERAL INVESTMENT

The general investment applicable either jointly to the various functions of the company, or specifically to the customer-Company business transactions has been assigned to all classes of service on the basis of the direct fixed capital allocated thereto. When the cost of any one of the major divisions, such as distribution, for a particular class of service, is to be ascertained a proportionate part of the general investment must be included in order that the true cost may be set forth.

A considerable portion of the general investment has been directly assigned, where possible, to the physical functions of the Company, thus leaving a relatively small portion to be distributed on the overhead burden basis. For instance the investment in transportation equipment was assigned according to usage as, line, meter, stores, service, credit, generation, and commercial with only the rental cars assigned on an overhead burden basis.

EXPENSES

The magnitude of the expenses used in this study were taken from the records in the standard classified accounts and were reconciled with the Annual Report. These expenses, as

classified in the accounts of course are not segregated by rate classes, except for the rural, the oilfield, the Eastern and the Western Districts, and a portion of the street lighting expenses and also the expenses in Rate Class I. The distribution expenses by standard accounts for Rate Class I were segregated directly before the remainder of the expenses were distributed to the several classes of service in Rate Class II, Rate Class III and Rate Class IV in proportion to the investment in each class of distribution equipment. It is realized that this basis of assigning distribution expenses is not absolutely accurate but, after careful consideration of the physical features of the territory, the design of the system, the location with respect to divisional and district headquarters, and particularly to the quality of service rendered, it is a reasonably close approximation. Actually over 48 per cent of the total distribution expenses were directly assignable to major industries and the classes of service, with the remaining portion allocated in proportion to the assigned investment.

POWER SYSTEM

GENERATING PLANTS

The nature of generating expense is such that for the purpose of this study it was necessary to group the detail expenses into fixed and variable values. This segregation of generating expenses into fixed and variable values was based upon a series of tests and analyses accumulated over past years.

Fixed Expense is that part of generation expense which does not vary with the amount of energy generated. It includes

such cost as superintendence, a portion of purchased energy and similar expense necessary for the preparation for carrying peak loads.

The fixed component, representing as it does, expense which is primarily determined by the size of the generating plant and peak load requirements, was distributed to classes on the basis of the non-coincident demands.

Variable Expense is that portion of generation cost which varies with the quantity of energy produced or purchased and includes the expense of fuel and portions of maintenance, labor and supplies. The variable expense was distributed on the basis of the kilowatt hours generated for each class.

The interchange energy purchases were virtually balanced by interchange sales so that only the net purchase cost was included in this study, as shown on the revenue reconcilement sheet.

Data on generating plant operation and maintenance expenses have been accumulated for several years and actual tests in each plant have been run to determine the stand-by fuel costs. Thus with these studies available it was possible to segregate the various major plant costs into the respective fixed and variable components with the following results:

7% of fuel cost at full load fixed; 93% of fuel cost variable

90% of labor cost fixed; 10% of labor cost variable

50% of maintenance expenses fixed; 50% of maintenance variable

100% of miscellaneous expenses fixed

The analysis of generating plant operating and mainte-

nance expenses revealed that, of the total costs for the year, 53.5% are fixed and 46.5% are variable.

It must be appreciated that these same relative percentages will not apply to other plants or utilities where the conditions may be totally different. For instance of the five major generating plants, only one burns coal as a fuel, one plant burns refinery coke and the remainder burn natural gas. The use of natural gas as a fuel eliminates the expense of maintaining fuel handling and pulverizing equipment which is required in a coal-fired plant, with the result that for these particular conditions the variable component is a smaller percentage of the total than may prevail under other circumstances in steam generating plants.

TRANSMISSION LINES AND SUBSTATIONS:

Expenses incurred for these facilities were allocated to the classes on the basis of the non-coincident demands.

DISTRIBUTION OPERATION AND MAINTENANCE

DISTRIBUTION SUBSTATIONS:

Expenses incurred for these facilities have been allocated to the classes of service using these facilities on the basis of the non-coincident demands.

LINES:

The allocation of these expenses to classes of service using the facility was made upon the same basis as was the assignment of investment in these facilities.

DISTRIBUTION TRANSFORMERS:

The expenses incurred for the operation and maintenance of distribution transformers and devices was distributed to the various classes of service using these facilities on the

same basis as was the investment in this equipment.

METERS:

The expenses of meters and metering equipment were distributed to the various classes of service in proportion to the assigned meter investment to each class.

SERVICES:

The expenses incurred for services were distributed to the classes of service in proportion to the assigned investment in services to each class.

UTILIZATION

The utilization expense was subdivided in the classified accounts between street lighting, which is chargeable direct to this class of service, and to general utilization expense for other classes of service. After due consideration of the nature of the expense which was incurred for all classes of service, it was allocated to the classes on the basis of the number of customers in each class.

COMMERCIAL

Consideration has been given to the nature of and manner in which these expenses were incurred and they have been distributed to the classes of service on the basis of the number of customers in each class.

NEW BUSINESS EXPENSE

The expenses incurred in the acquisition of new business were segregated in the classified accounts into the following classifications:

New Business

Publicity

Home Service

Sales Development

Small Proportion of Managers' Salaries and Expenses

Consideration has been given to the nature of and manner in which these expenses were incurred and have been distributed to classes of service in the following manner:

A fair portion of new business expense has been directly assigned to the rural customers. The remainder of new business expense was assigned to the Small and Large Light and Power and the Industrial classes of service in proportion to their gross revenue, as it is in acquisition of these classes of business that these expenses are incurred.

The publicity expense was assigned on the basis of the number of customers in each class. As the electric supply business is vested with more than ordinary public interest, practically all of the advertising of the company is designed to incur the good will of the voting public. With this fact in mind, it is but fair and equitable that these expenses be distributed on the basis of the number of customers in each class.

The home service expense was segregated into two portions, half was assigned to publicity and the other half was assigned to the residential class alone on the basis of the number of customers in each rate class.

Sales development expense, representing as it does the promotion of appliance sales, was assigned to the residential class of service alone and on the basis of the number of customers in each rate class. (This Company does not merchandise appliances.)

The proportion of managers' salaries and expenses were assigned to the overhead expense group.

UNCOLLECTIBLE ACCOUNTS

The Accounting Department ascertained the actual amount of uncollectible bills by classes of service within each rate class so that this item of expense was directly assigned to each class.

TAXES

Taxes were segregated into the following classifications:

Real, Personal and Capital Stock

Excise and Sales

Franchise

Income

The real and personal taxes paid on power supply facilities were assigned on the non-coincident demand basis to the industries and to the various classes of service. The remainder of the real and personal taxes and the capital stock tax were assigned on the basis of allocated investment to the various classes.

The federal excise taxes were distributed to the residential and commercial classes in proportion to the gross earnings. The state sales taxes were distributed to the residential, small and large light and power classes on the basis of their gross earnings.

The franchise and miscellaneous taxes were assigned to the various classes of service in proportion to the gross earnings for each class. A direct assignment of this item was made to the Eastern District.

The income taxes were assigned to the various classes in proportion to the net earnings of each class.

INSURANCE

The insurance expense was distributed to classes in proportion to the allocated power plant and building investment to each class.

GENERAL EXPENSES

General expenses, which are of an overhead nature, were distributed to the classes in proportion to the direct expenses allocated thereto.

General expenses which are of an overhead nature and which are applicable jointly to the several functions of the company but which are controlled and administered centrally and independent of the functional departmental responsibilities, obviously may be assigned on several different bases, any one of which may be defensible. There is no mathematically exact method of equitably distributing general overhead expenses. In this work the total of all direct assigned expenses was determined for each class of service and general overhead expenses have been prorated according to the total direct expenses.

Note: Electricity used in operations was absorbed in the expense of the various departmental functions.

The total property tax rate within the city limits of towns is practically always greater than the tax rate on property located outside of the corporate limits of towns. A detail analysis was therefore made in order to segregate the amount of taxes paid on the power plants and transmission facilities investments from the amount of taxes paid on distri-

bution property, thus permitting the determination of the total power system expenses separately from the total distribution expenses for each class of service.

SUMMARY OF

BASIS OF INVESTMENT ALLOCATIONS

Investment Account	Demand, Energy or Customer Value	Basis for Allocation
POWER SYSTEM		
Plants	Demand	*NCP
Fuel in storage	Energy	Kwhr
Transmission lines	Demand	NCP
Transmission Subs.	Demand	NCP
General investment	Overhead	Allocated Invest.
DISTRIBUTION SYSTEM		
Substations	Demand	NCP
Poles & Lines:		
Customer portion	Customer	No. of customers
Demand "	Demand	NCP
Street Lighting	Customer	Analysis
Transformers & Devices:		
Customer portion	Customer	No. of customer
Demand "	Demand	NCP
Meters	Customer	Analysis
Services	Customer	Analysis
St. Ltg. Equipment	Customer	Analysis
General investment	Overhead	Allocated Invest.

*Annual non-coincident peak Kw demand

SUMMARY OF

BASIS OF EXPENSE ALLOCATIONS

Account	Demand, energy or customer value	Basis for Allocation
POWER SYSTEM		
Plant Costs:		
Fixed	Demand	NCP
Variable	Energy	Kwhr
Plant taxes	Overhead	Allocated plant invest.
Transmission lines	Demand	NCP
" Subs.	Demand	NCP
" taxes	Overhead	Allocated line invest.
General expenses	Overhead	Allocated power system investment
DISTRIBUTION & UTILIZATION		
Substations	Demand	NCP
Lines	Demand & Customer	Analysis
Meters	Customer	Analysis
Transformers	Demand & Customer	Analysis
Services	Customer	Analysis
Installation	Customer	Analysis
Street Lighting		Acct. records
Commercial	Customer	Analysis
Uncollectible Accts.	Customer	Acct. records
New business	Customer	Analysis
Insurance	Demand & Customer	Allocated power system investment
Taxes:		
*R & P	Overhead	Allocated distribution investment
Excise & Sales	Customer	Gross Revenue
Franchise	Customer	Gross Revenue
Income	Customer & Demand	Allocated distribution expenses

*R & P taxes on distribution property

DEFINITIONS

POWER SYSTEM

GENERATING PLANTS:

All facilities and rights applicable to the cost of purchased energy and all labor, rent, supplies and fuel employed in the processes of producing electrical energy, and in its collection on busses and delivery to the terminals or potheads of lines eminating from the generating station substations.

Primary plants include:

Plant	Capacity in Kw
#1	65,000
#2	30,000
#3	15,000
#4	22,500
#5	14,496

Secondary plants include:

#1	10,000
#2	1,000
#3	750
#4	890
#5	3,000
Contract firm capacity	4,500
	167,136

TRANSMISSION LINES:

All transmission line facilities and rights-of-way primarily applicable to, and all labor, rent and supplies primarily employed in the interconnection of generating stations or systems or in the process of bulk delivery of electric service to towns to groups of customers and to large industrial customers outside of the towns, to allow an economical energy transfer or an increase in reliability of service between power supply and load centers, and includes all lines of 13 kv and above.

TRANSMISSION SUBSTATIONS:

All transmission line transforming, switching and regulating station facilities and rights-of-way applicable to, and all labor and rent primarily employed in the transformation, switching or regulation of electric service to allow an economical energy transfer or an increase in reliability of service between generation and load centers and includes all such facilities from the generating plants to the secondary terminals of all substations having voltages of 13 kv and above. The accounting records were not classified consistently with this definition and it therefore was necessary to make a detailed analysis of the cost reports of 54 substations in order to classify this investment properly.

DISTRIBUTION SYSTEM

All facilities and rights-of-way applicable to and all labor and rent employed in the process of delivery of electric service from the transmission lines including that portion of the transmission substations exclusively used in serving the towns and large industrial customers outside of the towns, to the customers' premises, including metering of said service.

DISTRIBUTION SUBSTATIONS:

All facilities applicable to, and all labor and rent employed in the process of transformation, switching and regulation of electric service between the transmission lines or substations and distribution transformers within the respective classes of towns, and includes all substations below 13 kv.

POLES AND CONDUCTORS:

All facilities, rights-of-way and all labor and rent exclusive of substations and transformers, used in the delivery

of electric service from the low tension terminals of the substations to, but not including, the customers' services.

DISTRIBUTION TRANSFORMERS AND DEVICES:

All facilities applicable to and all labor and rent on transformers and devices operating with primary voltage of less than 13 kv.

METERS:

All facilities applicable to, and all labor employed, except meter reading, in measuring quantitatively, either energy or demand, the amount of service used by an individual customer.

SERVICES:

All facilities from an aerial or underground main to the point of connection with the house wiring, including meter protective devices, but not the meter.

STREET LIGHTING EQUIPMENT:

All facilities and all labor upon equipment operated and maintained under contract for public lighting, except circuit and pole lines.

GENERAL INVESTMENT

Investment in tangible property such as land, buildings and equipment of main and district offices, transportation, stores, shops, laboratory, materials and supplies on hand, etc., which are not specifically applicable to or employed in, the physical production, transmission, transformation, regulation, distribution or utilization functions of electric service, but applicable either jointly to these functions or specifically to the customer-company business transaction activities.

UTILIZATION EXPENSES

STREET LIGHTING OPERATION AND MAINTENANCE:

All renewals and labor employed in the operation and maintenance of street lighting lamps and fixtures.

CONSUMERS INSTALLATION:

All labor and materials furnished without charge to consumers for work on the consumer's premises.

COMMERCIAL EXPENSES

All labor, supplies and expenses incurred by the utility in meter reading, billing, bookkeeping of accounts, and supplies, collections and contracts, which constitute the transaction of business functions of electric service supply between the Company and its consumers.

NEW BUSINESS EXPENSE

All labor, supplies and expenses incurred in the commercial, (industrial and commercial new business), publicity, sales development and home service work of the Company.

UNCOLLECTIBLE ACCOUNTS

Includes actual charges for accounts due from consumers or customers which were determined to be uncollectible.

TAXES

All sums required to be paid to a governmental authority, including licenses and fees of any kind or character, and levied or assessed by said authorities upon the property and income of the Company.

INSURANCE

Includes premiums paid for fire, fidelity, boiler, casualty, burglary and lightning insurance.

GENERAL EXPENSES

All expense of a general administrative nature, superintendence, managers' salary and expense, employees relief and welfare, subscriptions, injuries and damages, etc., which can not be assigned to the physical production, transmission, conversion, distribution or utilization of electric service, or to customer-company business transaction functions, which are either applicable jointly to these functions, or controlled and administered centrally and independent of the functional departmental responsibilities.

CUSTOMER

Any person, partnership, corporation or association lawfully receiving electric service from the Company at one location has been classified as a customer within one of the composite classes of service for which costs are being determined. Thus, in cases where service is billed on one account but supplied at two or more locations, the definition would classify these as two or more customers. Customers supplied at a single location but served through two or more meters even though on different rate schedules but within one of the classes of service for which costs were being determined was classified as one customer. On the other hand, service taken at one location but within two or more classes of service for which costs are being determined was classified as two or more customers within the respective classes of service. This classification of customers required some considerable amount of work and analysis by the Accounting Department. The number of customers shown for each class of service represents the average number for the twelve month period.

RATE CLASS

A rate class is composed of a group of towns in which the residential and commercial customers had the same, or very similar rate schedules during the year.

Rate Class I included a city of over 200,000 population and four suburban communities.

Rate Class II included 15 towns having more than 1000 electric customers each.

Rate Class III included 43 towns having more than 200 and less than 1000 electric customers each.

Rate Class IV included 142 towns having more than 30 and less than 200 electric customers each.

The Western District included 11 small towns.

The Eastern District included 21 towns below 31,000 population.

Towns having less than 30 electric customers are classified as rural.

CLASS OF SERVICE

Collective grouping of individual customers or services possessing essential properties and characteristics in common, the nature of which forms a distinguishing attribute of the group.

It was not practicable to meter the diversified load of the commercial lighting customers separately from the single phase power they use. Consequently, it was advisable to combine the commercial lighting customers with their use of single phase power, thus resulting in the Small Light and Power classification which is composed of all commercial lighting business and all single phase power of customers having demands below 10 kw or an annual consumption below 20,000 kwhr per year per customer. This reclassification was made because the load characteristics of the small light and power customers

were available and because the tendency in rate structures seems to be thus to classify the commercial customers. These particular values of demand and consumption were used because the demand rate schedule applies to customers having demands as low as 10 kw and an analysis of a large number of individual customer records revealed that a total annual consumption of about 20,000 kwhr was the value above which customers were served on the demand type of rate.

The oilfield business, whether served within or without the confines of towns has been studied and classified in one group.. This class of business, it will be noted, constitutes a large portion of the entire industrial load of the company. Electric service is supplied to two of the major producing oilfields of the world and includes every phase of the industry such as drilling, producing and pipe line pumping.

The refinery business is a relatively permanent industrial load and has therefore been segregated from the production portion of the oil business and studied as a separate class of service.

The grain and milling business includes not only individual units of feed or alfalfa mills and individual elevators but also large integrated mills some of which manufacture over a hundred different products.

The Western and the Eastern Districts have been analyzed as complete units, without making a study by classes of service, because of certain difficulties in the limited time available of obtaining a complete classification of the capital investment in local distribution facilities. The Eastern District is supplied from the main interconnected

power system though the Western District is supplied by a small system which is totally isolated from the main power system. Due consideration was given to these facts in making the allocations.

NON-COINCIDENT PEAK (NCP)

The maximum load in kilowatts imposed by a rate class, industry, or by a class of service, upon the Company's system in the particular year being studied.

RESULTS OF THE STUDY

Charts V and VI portray graphically in condensed form the investment, expenses, and rate of return before retirement of the several classes of service. The composite rate of return for the entire system was 7.65%, or a net return of $5,226,249 on an investment of $68,319,754, before provision for retirement.

On chart V the results are shown for each class of service and are arranged according to the relative profitableness of the business. It will be observed that the Resale and the Small Light and Power business are the most profitable, indicating a rate of return of 10.28% and 9.73% respectively, while the Cotton Gins and the Western District are the least profitable, both actually entail a deficit of $45,017 and $348 respectively.

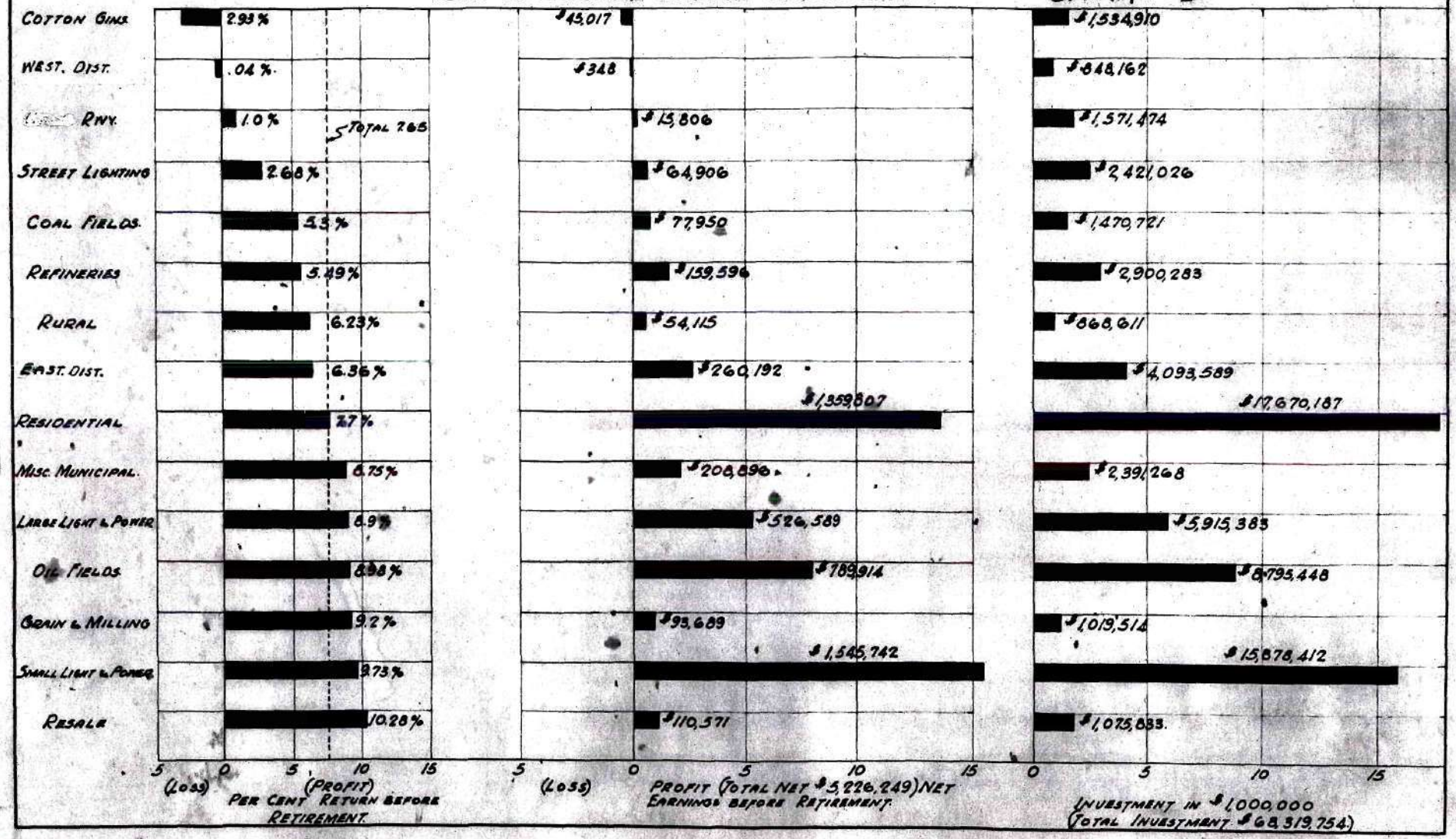
With respect to actual net revenue to the company it will be noted that the Small Light and Power business yields $1,545,742, the Residential business $1,359,807 and the oilfield business $789,914. These classes of business together with the Refineries yield about 75% of the total net earnings of the company.

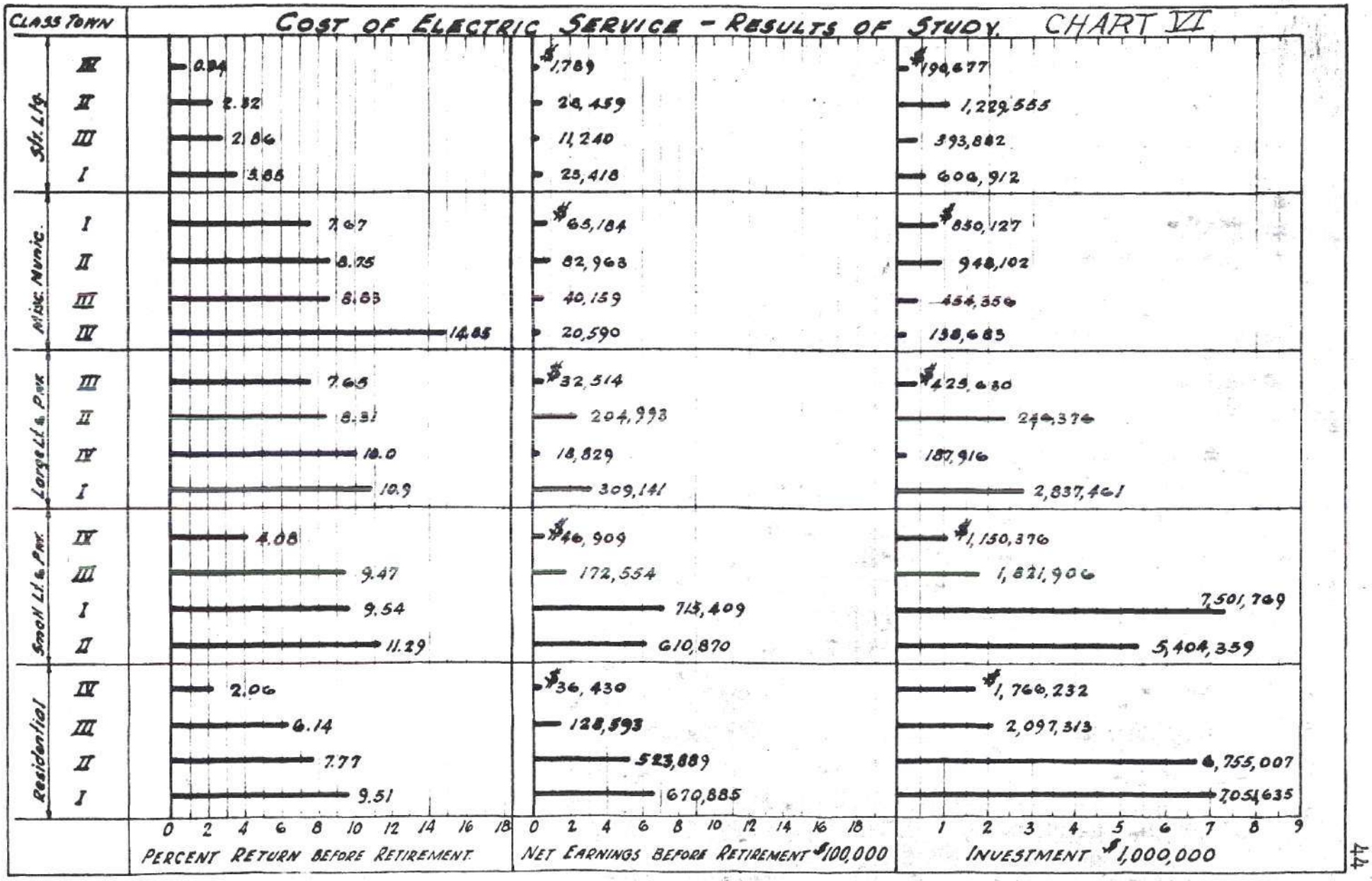
On chart VI the results are summarized graphically portraying the relative rates of return, the net earnings before retirement and the investment of the several classes of service within the various classes of towns. It will be noted that as a rule the business in the larger classes of towns indicates the higher rate of return.

On pages 46 to 51 inclusive are tabulated the results of the study showing by classes of service:

COST OF ELECTRIC SERVICE - RESULTS OF STUDY.

CHART V




CLASS TOWN
COST OF ELECTRIC SERVICE - RESULTS OF STUDY. CHART VI
St. Lig.
Misc. Munic.
Large Lt & Pwr.
Small Lt & Pwr.
Residential
IV
III
II
I
0.34
2.32
2.86
3.85
7.07
8.75
8.83
14.85
7.65
8.31
10.0
10.9
4.08
9.47
9.54
11.29
2.06
6.14
7.77
9.51
$1,789
28,459
11,240
25,418
$65,184
82,968
40,159
20,590
$32,514
204,993
18,829
309,141
$46,909
172,554
713,409
610,870
$36,430
128,593
523,889
670,885
$194,677
1,229,555
393,882
604,912
$850,127
948,102
454,356
138,685
$425,680
240,376
187,916
2,837,461
$1,150,376
1,821,906
7,501,709
5,404,359
$1,760,232
2,097,313
6,755,007
7,054,635
0 2 4 6 8 10 12 14 16 18
PERCENT RETURN BEFORE RETIREMENT
0 2 4 6 8 10 12 14 16 18
NET EARNINGS BEFORE RETIREMENT $100,000
1 2 3 4 5 6 7 8 9
INVESTMENT $1,000,000

1. Investment
2. Gross revenue
3. Expenses before retirement
4. Net earnings before retirement
5. Percent return before retirement
6. Annual kwhr sales
7. Average number of customers
8. Diversified annual peak Kw demand
9. Annual load factor
10. Revenue per Kw of demand
11. Kwhr sales per customer per year

These results are shown not only by classes of service but are summarized by towns for the various rate classes.

Pages 52 to 61 inclusive summarize the allocated investment and expenses to the various classes of service and are shown for the major classifications of investment and expense.

It is important to note that the net revenue shown is the amount available for fixed charges such as interest on the investment, physical depreciation and obsolescence.

RESULTS OF THE STUDY

RATE OF RETURN BY CLASSES OF SERVICE AND PRINCIPAL INDUSTRIES

	Investment	Gross Revenue	Expenses Before Retirement	Net Earnings Before Retirement	% Return Before Retirement
Total	$68 319 754	$11 250 521	$6 024 272	$5 226 249	7.65
Residential	17 670 187	3 413 344	2 053 537	1 359 807	7.7
Small Light and Power	15 878 412	2 890 287	1 344 545	1 545 742	9.73
Large Light and Power	5 915 383	981 139	454 550	526 589	8.9
Misc. Municipal	2 391 268	380 586	171 690	208 896	8.75
Street Light	2 421 026	267 295	202 389	64 906	2.68
Rural	868 611	134 517	80 402	54 115	6.23
Oilfield	8 795 448	1 441 684	651 770	789 914	8.98
Refineries	2 900 283	351 546	191 950	159 596	5.49
Street Railway	1 571 474	114 582	98 776	15 806	1.0
Resale	1 075 833	181 357	70 786	110 571	10.28
Cotton Gins	1 534 910	37 986	83 003	45 017	2.93
Grain and Milling	1 019 514	175 268	81 579	93 689	9.2
Coalfield	1 470 721	155 130	77 180	77 950	5.3
Eastern Dist.	4 093 589	641 370	381 178	260 192	6.36
Western Dist.	848 162	84 430	84 778	348	0.04

CHARACTERISTICS OF THE VARIOUS CLASSES OF SERVICE AND PRINCIPAL INDUSTRIES

	Kwh Sold	Average No. Cust.	Kw Demand (At Subs)	Annual Load Factor	Revenue Per Kw	Diversity (Intra-Class)
Residential	63 139 102	100 047	27 800	25.85	$132 00	
Small Light and Power	69 072 041	20 233	34 900	22.55	88 20	
Large Light and Power	47 356 959	2 079	15 950	33.9	73 70	
Misc. Municipal	18 552 339	1 236	5 630	37.6	71 60	
Street Lighting	6 606 275	144	1 542	48.8	183 20	
Rural	1 960 556	1 229	595	37.6	226 00	
Oilfield	121 648 196	2 253	18 600	74.6	77 50	
Refineries	40 760 168	28	8 750	53.2	40 20	1.34
Railway	13 601 293	1	4 450	34.9	25 70	
Resale	10 059 252	18	3 280	35	55 30	1.23
Cotton Gins	846 135	152	3 870	2.49	9 80	1.09
Grain and Milling	12 219 225	134	2 630	53	66 70	1.32
Coalfields	5 262 247	217	4 410	13.6	35 20	1.3

RESULTS OF THE STUDY

RATE OF RETURN BY CLASSES OF SERVICE

Rate Class I

	Total	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Munic.	Street Lighting
Total Investment	$18 847 704	$7 051 635	$7 501 769	$2 837 461	$850 127	$606 912
Gross	3 483 478	1 495 607	1 277 264	514 620	119 389	76 598
Expenses	1 699 441	824 722	561 855	205 479	54 205	53 180
Net (Before Retirement)	1 784 037	670 885	715 409	309 141	65 184	23 418
Per cent Return	9.47	9.51	9.54	10.9	7.67	3.85
kwhr Sold	94 523 195	28 588 435	36 494 009	19 876 067	7 453 261	2 111 423
Average No. Customers	44 151	38 034	5 185	674	254	4
kwhr per Cust. per Year		751	7 050	29 400	29 300	-
kw Demand at Substation		11 250	16 400	6 200	2 170	512
Annual Load Factor		29	25.4	36.6	39.2	47.1

RESULTS OF THE STUDY

RATE OF RETURN BY CLASSES OF SERVICE

Rate Class II

	Total	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting
Total Investment	$16 801 399	$6 755 007	$5 404 359	$2 464 376	$948 102	$1 229 555
Gross	3 128 022	1 337 455	1 106 454	404 170	151 436	128 507
Expenses	1 676 838	813 556	495 584	199 177	68 473	100 048
Net (Before Retirement)	1 451 184	523 899	610 870	204 993	82 963	28 459
Per cent Return	8.64	7.77	11.29	8.31	8.75	2.32
kwhr Sold	69 966 116	22 388 384	21 778 843	15 886 111	6 957 596	2 955 182
Average No. Customers	44 633	36 116	7 231	848	424	14
kw Demand at Substation		10 420	11 800	5 830	2 280	770
Annual Load Factor		24.4	21	31.1	34.8	43.8
kwhr per Cust. per Year		620	3 010	18 700	16 400	-

RESULTS OF THE STUDY

RATE OF RETURN BY CLASSES OF SERVICE

Rate Class III

	Total	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting
Total Investment	$ 5 193 087	$2 097 313	$1 821 906	$ 425 630	$ 454 356	$393 882
Gross	903 467	369 763	348 851	66 271	73 287	45 295
Expenses	518 407	241 170	176 297	33 757	33 128	34 055
Net (Before Retirement)	385 060	128 593	172 554	32 514	40 159	11 240
Per cent Return	7.41	6.14	9.47	7.65	8.83	2.86
Kwhr Sold	17 014 333	5 565 873	5 260 863	2 610 666	2 625 425	951 506
Average No. Customers	14 485	10 623	3 499	111	217	35
Kwhr per Cust. per Year		523	1 500	23 500	12 100	-
Kw Demand at Substation		2 650	3 100	935	750	232
Annual Load Factor		23.95	19.4	31.9	40	46.8

RESULTS OF THE STUDY

RATE OF RETURN BY CLASSES OF SERVICE

Rate Class IV

	Total	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting
Total Investment	$3 433 884	$1 766 232	$1 150 376	$ 187 916	$138 683	$190 677
Gross	456 572	210 519	157 718	34 966	36 474	16 895
Expenses	332 025	174 089	110 809	16 137	15 884	15 106
Net (Before Retirement)	124 547	36 430	46 909	18 829	20 590	1 789
Per cent Return	3.63	2.06	4.08	10	14.85	0.94
Kwhr Sold	7 296 015	2 721 797	2 034 118	1 346 220	895 792	298 088
Average No. Customers	9 862	6 804	2 723	36	219	80
Kwhr per Cust. per Year		400	746	37 400	4 090	-
Kw Demand at Substation		1 540	1 310	414	230	75
Annual Load Factor		20.2	17.6	37	44.5	45.4

ALLOCATION OF INVESTMENT TO THE VARIOUS CLASSES OF SERVICE AND PRINCIPAL INDUSTRIES

Account	Total Investment	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting	Rural	Oilfield	Refineries	Street Railway	Resale	Cotton Gins	Grain and Milling	Coalfields	Eastern Distric	Western District
Power System																
Plants	$23 093 438	$ 4 431 857	$ 5 635 326	$2 264 955	$ 933 924	$ 256 057	$103 205	$3 232 001	$1 509 348	$ 764 677	$ 564 161	$ 659 591	$ 453 454	$ 754 976	$1 210 833	$318 573
Transm.	16 300 192	3 130 212	3 982 990	1 596 305	658 107	179 722	72 218	2 254 803	1 108 800	539 227	398 000	468 614	317 759	534 413	855 251	203 771
	39 393 630	7 562 069	9 618 816	3 861 260	1 592 031	435 779	175 423	5 486 804	2 618 148	1 303 904	962 161	1 128 205	771 213	1 289 389	2 066 084	522 344
General	684 000	130 986	167 101	67 100	27 634	7 592	3 010	95 418	45 418	22 709	16 758	19 562	13 406	22 435	35 842	9 029
Total Power System	40 077 630	7 693 055	9 785 917	3 928 360	1 619 665	443 371	178 433	5 582 222	2 663 566	1 326 613	978 919	1 147 767	784 619	1 311 824	2 101 926	531 373
Distribution	25 505 615	9 011 144	5 379 204	1 794 373	696 896	1 786 099	623 408	2 901 811	213 730	221 053	87 610	349 653	212 182	143 573	1 798 739	286 140
General	2 736 509	365 983	578 224	192 650	74 707	191 556	66 770	311 415	22 987	23 808	9 304	37 490	22 713	15 324	192 924	30 649
Total Distribution	28 242 124	9 977 132	5 957 428	1 987 023	771 603	1 977 655	690 178	3 213 226	236 717	244 861	96 914	387 143	234 895	158 897	1 991 663	316 789
Total Investment	68 319 754	17 670 187	15 743 345	5 915 383	2 391 268	2 421 026	868 611	8 795 448	2 900 283	1 571 474	1 075 833	1 534 910	1 019 514	1 470 721	4 093 589	848 162

ALLOCATION OF EXPENSES TO THE VARIOUS CLASSES OF SERVICE AND PRINCIPAL INDUSTRIES

Account	Total Expenses	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting	Rural	Oilfield	Refineries	Railway	Resale	Cotton Gins	Grain and Milling	Coalfields	Eastern District	Western District
Power System																
Production:																
Fixed	$ 667 329	$ 130 179	$ 165 591	$ 66 410	$ 27 370	$ 7 479	$ 3 000	$ 93 650	$ 44 200	$22 420	$16 560	$19 500	$13 200	$ 22 200	$ 35 570	$ -
Variable	564 895	84 370	95 450	57 120	24 805	7 865	3 160	163 270	51 100	17 110	12 930	1 525	15 260	7 450	23 480	-
Taxes	192 126	37 472	47 668	19 123	7 894	2 137	865	26 994	12 700	6 455	4 765	5 610	3 804	6 398	10 241	-
Western	31 081	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31 081
Total	1 455 431	252 021	308 709	142 653	60 069	17 481	7 025	283 914	108 000	45 985	34 255	26 635	32 264	36 048	69 291	31 081
Gen Expense	341 000	60 630	75 291	33 452	14 015	3 990	1 603	61 789	24 484	10 878	8 082	7 127	7 332	9 139	16 641	6 547
Trans Lines	194 842	38 004	48 344	19 393	8 005	2 167	877	27 375	12 879	6 547	4 832	5 689	3 858	6 488	10 384	-
" Subs	137 000	26 722	33 992	13 636	5 628	1 524	616	19 249	9 056	4 603	3 398	4 000	2 713	4 562	7 301	-
" Western	6 234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6 234
" Taxes	147 800	28 829	36 671	14 711	6 072	1 644	665	20 766	9 770	4 966	3 665	4 316	2 926	4 922	7 877	-
Total Pwr Sys	2 282 307	406 206	503 007	223 845	93 789	26 806	10 786	413 093	164 189	72 979	54 232	47 767	49 093	61 159	111 494	43 862
Distb and Utilization	885 609	313 039	189 044	66 153	22 071	87 114	17 760	66 331	4 168	9 661	3 835	15 672	10 337	1 922	67 438	11 064
Commercial	417 698	295 111	60 048	5 367	3 583	426	3 968	7 268	100	50	50	500	418	710	34 209	5 890
Uncollectible	51 348	8 558	6 032	10 825	3 879	477	-	19 469	-	-	434	-	-	985	465	224
New Business	341 498	194 136	56 649	14 182	1 314	155	16 455	19 955	4 232	-	2 170	637	2 252	2 121	24 635	2 605
Insurance	66 729	13 446	16 188	6 460	2 582	941	367	9 222	4 157	2 122	1 555	1 855	1 268	2 089	3 563	914
Taxes:																
R & P (Distb)	424 230	161 966	96 761	32 312	12 529	32 132	5 800	27 000	1 990	3 980	815	6 290	3 820	1 335	32 350	5 150
Excise & Sales	263 528	121 809	103 007	4 414	-	-	4 805	6 243	1 522	495	784	165	756	674	16 557	2 297
Franchise, Misc	140 239	53 059	44 870	15 834	5 907	4 148	-	-	266	1 781	-	519	2 594	-	9 957	1 304
Income	130 000	36 725	36 374	12 259	4 797	2 301	1 469	18 044	3 770	663	2 418	-	2 158	1 794	6 890	338
Total Taxes*	957 997	373 559	281 012	64 819	23 233	38 581	12 074	51 287	7 548	6 919	4 017	6 974	9 328	3 803	65 754	9 089
Allocatable Expenses	4 662 186	1 543 425	1 036 689	358 199	136 436	150 510	59 807	524 836	159 910	80 853	58 211	66 278	65 364	63 650	290 917	67 101
Gen Expenses, Distb.	1 021 086	449 482	228 724	62 899	21 239	47 889	18 992	65 145	7 556	7 045	4 493	9 598	8 883	4 391	73 620	11 130
Total Expenses	6 024 272	2 053 537	1 340 704	454 550	171 690	202 389	80 402	651 770	191 950	98 776	70 786	83 003	81 579	77 180	381 178	84 778

*Power System Taxes shown above.

CLASS I

ALLOCATION OF INVESTMENT TO THE VARIOUS CLASSES OF SERVICE

Account	Total Investment	Residential	Small Light and Power	Large Light and Power	Misc. Municipal	Street Lighting
Power System						
Plant	$6 269 105	$1 924 160	$2 848 577	$1 045 805	$369 255	$ 81 308
Fuel in storage	55 310	16 583	21 928	11 553	4 159	1 087
Trans Lines	3 511 280	1 077 636	1 595 063	586 064	206 929	45 588
Trans Subs	950 323	291 662	431 541	158 750	56 137	12 233
Gen Invest (Pwr Sys)	187 289	57 398	85 054	31 335	11 051	2 451
Total Power System	10 973 307	3 367 439	4 982 163	1 833 507	647 531	142 667
Distribution System*						
Subs	1 321 487	410 860	598 469	226 464	66 989	18 705
Poles and Lines:						
Cust.	1 078 000	928 805	126 665	16 385	6 145	-
Primary	1 822 219	580 428	848 469	320 857	(52 815	
					(19 650	-
St Ltg	291 218	-	-	-	-	291 218
Transf and Devices:						
Cust.	202 218	174 230	23 761	3 074	1 153	-
Demand	704 377	225 924	330 256	124 890	(20 557	
					(2 750	-
Meters	854 345	522 499	205 398	118 918	7 530	-
Services	728 396	485 000	142 000	96 000	5 396	-
St Ltg Equip	109 306	-	-	-	-	109 306
	7 111 566	3 327 746	2 275 018	906 588	182 985	419 229
Gen Invest (Distb)	763 031	356 450	244 588	97 366	19 611	45 016
Total Distb	7 874 597	3 684 196	2 519 606	1 003 954	202 596	464 245
Total Investment	18 847 904	7 051 635	7 501 769	2 837 461	850 127	606 912

*Includes an underground network of 12,000 Kw capacity

CLASS I

ALLOCATION OF EXPENSES TO THE VARIOUS CLASSES OF SERVICE

Account	Total Expense	Resi-dential	Small Lgt. and Power	Large Lgt. and Power	Misc. Munic.	Street Lighting
Power System						
Fixed	$ 185 534	$ 56 947	$ 84 255	$ 30 986	$10 940	$ 2 406
Variable	133 930	40 200	53 100	27 930	10 070	2 630
Taxes	53 410	16 391	24 253	8 923	3 156	687
	372 874	113 538	161 608	67 839	24 166	5 723
Trans Lines	54 167	16 624	24 598	9 048	3 200	697
" Subs	38 088	11 690	17 295	6 363	2 250	490
" Taxes	41 089	12 611	18 659	6 863	2 427	529
	133 344	40 925	60 552	22 274	7 877	1 716
General	87 308	26 526	38 278	15 605	5 616	1 283
Total Pwr Sys	593 526	180 989	260 438	105 718	37 659	8 722
Distb and Utilization						
Substation	20 756	6 399	9 309	3 524	1 233	291
Lines	54 638	25 844	16 692	5 775	1 344	4 983
Meters	45 469	27 782	10 958	6 329	400	-
Transf	16 545	7 305	6 461	2 333	446	-
Services	9 471	6 305	1 847	1 249	70	-
Installation	48 800	29 817	11 761	6 793	429	-
St Ltg Util.	17 124	-	-	-	-	17 124
Total	212 803	103 452	57 028	26 003	3 922	22 398
Commercial	142 375	122 656	16 729	2 164	812	14
Uncollectible	8 804	3 957	1 728	3 119	-	-
New Business	109 367	80 665	21 443	6 957	298	4
Insurance	18 295	5 785	8 184	3 023	1 021	282
Taxes:						
R & P	128 000	59 840	40 960	16 358	3 290	7 552
Excise & Sales	101 118	53 420	45 470	2 228	-	-
Franchise, Misc	54 105	23 244	19 829	7 986	1 856	1 190
Income	43 926	18 113	16 786	6 701	1 496	830
Total Taxes*	327 149	154 617	123 045	33 273	6 642	9 572
General Expense	287 122	172 601	73 260	25 222	3 851	12 188
Total Expenses	1 699 441	824 722	561 855	205 479	54 205	53 180

*Power System Taxes shown above

CLASS II

ALLOCATION OF INVESTMENT TO THE VARIOUS CLASSES OF SERVICE

Account	Total Investment	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting
Power System						
Plant	$5 322 304	$1 779 499	$2 049 796	$ 982 800	$387 625	$122 584
Fuel in storage	41 488	13 262	13 045	9 693	3 966	1 522
Trans Lines	2 982 593	997 271	1 148 605	550 784	217 234	68 699
Trans Subs	807 227	269 912	310 753	149 194	58 933	18 435
Gen Invest (Pwr Sys)	158 812	52 945	61 210	29 390	11 592	3 675
Total Power System	9 312 424	3 112 889	3 583 409	1 721 861	679 350	214 915
Distribution System						
Subs	1 096 079	371 305	420 255	201 770	75 289	27 460
Poles and Lines:						
Cust.	1 740 000	1 408 530	281 880	33 060	16 530	-
Primary	749 412	249 847	282 992	136 229	(33 144	-
					(47 200	-
St Lgt	472 608	-	-	-	-	472 608
Transf and Devices:						
Cust.	179 056	144 946	29 007	3 402	1 701	-
Demand	519 546	177 169	200 672	96 602	(23 503	
					(21 600	-
Meters	861 591	470 735	263 178	111 678	16 000	-
Services	728 579	467 000	166 029	87 800	7 750	-
St Lgt Equip.	416 304	-	-	-	-	416 304
	6 763 175	3 289 532	1 644 013	670 541	242 717	916 372
Gen Invest (Distb)	725 800	352 586	176 937	71 974	26 035	98 268
Total Distb	7 488 975	3 642 118	1 820 950	742 515	268 752	1 014 640
Total Investment	16 801 399	6 755 007	5 404 359	2 464 376	948 102	1 229 555

CLASS II

ALLOCATION OF EXPENSES TO THE VARIOUS CLASSES OF SERVICE

Account	Total Expense	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Munic.	Street Lighting
Power System						
Fixed	$ 157 604	$ 52 699	$ 60 672	$ 29 121	$11 486	$ 3 626
Variable	100 366	32 040	31 580	23 456	9 610	3 680
Taxes	45 369	15 170	17 466	8 385	3 312	1 036
	303 339	99 909	109 718	60 962	24 408	8 342
Trans Lines	46 012	15 385	17 713	8 504	3 359	1 051
" Subs	32 352	10 818	12 455	5 979	2 361	739
" Taxes	34 903	11 671	13 436	6 451	2 548	797
	113 267	37 874	43 604	20 934	8 268	2 587
General	74 625	24 555	27 594	14 669	5 872	1 935
Total Pwr Sys	491 231	162 338	180 916	96 565	38 548	12 864
Distb and Utilization						
Substation	45 546	15 281	17 376	8 563	3 197	1 129
Lines	65 078	36 411	12 430	3 716	2 128	10 393
Meters	56 794	31 010	17 379	7 349	1 056	-
Transf	17 507	8 071	5 751	2 507	1 178	-
Services	15 047	9 647	3 428	1 813	159	-
Installation	50 484	27 564	15 448	6 533	939	-
St Ltg Util.	32 018	-	-	-	-	32 018
Total	282 474	127 984	71 812	30 481	8 657	43 540
Commercial	143 674	116 275	23 261	2 730	1 365	43
Uncollectible	14 912	3 416	3 448	6 622	1 426	-
New Business	104 677	76 526	21 792	5 843	500	16
Insurance	15 658	5 419	5 884	2 817	1 075	463
Taxes:						
R & P	121 600	59 146	29 549	12 051	4 365	16 489
Excise & Sales	88 909	47 704	39 454	1 751	-	-
Franchise, Misc	48 593	20 798	17 178	6 278	2 347	1 992
Income	35 862	14 157	14 346	4 444	1 907	1 008
Total Taxes*	294 964	141 805	100 527	24 524	8 619	19 489
General Expense	329 248	179 793	87 944	29 595	8 283	23 633
Total Expenses	1 676 838	813 556	495 584	199 177	68 473	100 048

*Power System Taxes shown above

CLASS III

ALLOCATION OF INVESTMENT TO THE VARIOUS CLASSES OF SERVICE

Account	Total Investment	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting
Power System						
Plant	$1 313 011	$ 452 450	$ 538 225	$ 157 649	$127 719	$ 36 968
Fuel in storage	10 012	3 305	3 157	1 545	1 515	490
Trans Lines	735 870	253 562	301 634	88 350	71 606	20 718
Trans Subs	199 150	68 627	81 606	23 932	19 426	5 559
Gen Invest (Pwr Sys)	39 174	13 465	16 058	4 724	3 819	1 108
Total Power System	2 297 217	791 409	940 680	276 200	224 085	64 843
Distribution System						
Subs	334 478	109 987	128 782	29 892	56 200	9 617
Poles and Lines:						
Cust.	674 000	495 795	162 973	5 122	10 110	-
Primary	512 160	168 324	197 108	45 888	(5 840	
					(95 000	-
St Ltg	143 923	-	-	-	-	143 923
Transf and Devices:						
Cust.	80 500	59 216	19 465	612	1 207	-
Demand	176 827	63 683	74 573	17 361	(2 210	
					(19 000	-
Meters	293 137	135 155	125 618	18 068	14 296	-
Services	256 460	147 200	87 130	18 000	4 130	-
St Ltg Equip	143 662	-	-	-	-	143 662
	2 615 147	1 179 360	795 649	134 943	207 993	297 202
Gen Invest (Distb)	280 723	126 544	85 577	14 487	22 278	31 837
Total Distb	2 895 870	1 305 904	881 226	149 430	230 271	329 039
Total Investment	5 193 087	2 097 313	1 821 906	425 630	454 356	393 882

CLASS III

ALLOCATION OF EXPENSES TO THE VARIOUS CLASSES OF SERVICE

Account	Total Expense	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Munic.	Street Lighting
Power System						
Fixed	$ 38 883	$ 13 399	$ 15 933	$ 4 671	$ 3 786	$ 1 094
Variable	24 227	8 000	7 650	3 733	3 660	1 184
Taxes	11 194	3 857	4 587	1 345	1 092	313
	74 304	25 256	28 170	9 749	8 538	2 591
Trans Lines	11 352	3 912	4 652	1 364	1 107	317
" Subs	7 982	2 750	3 271	959	779	223
" Taxes	8 610	2 967	3 528	1 035	840	240
	27 944	9 629	11 451	3 358	2 726	780
General	18 372	6 233	7 266	2 355	1 934	584
Total Pwr Sys	120 620	41 118	46 887	15 462	13 198	3 955
Distb and Utilization						
Substation	13 899	4 806	5 615	1 696	1 361	421
Lines	29 232	14 601	7 913	1 120	2 438	3 160
Meters	19 320	8 916	8 271	1 190	943	-
Transf	6 450	3 077	2 361	450	562	-
Services	5 308	3 048	1 802	373	85	-
Installation	17 174	7 926	7 352	1 058	838	-
St Ltg Util.	11 045	-	-	-	-	11 045
Total	102 428	42 374	33 314	5 887	6 227	14 626
Commercial	46 699	34 254	11 278	355	700	112
Uncollectible	3 507	610	380	990	1 090	437
New Business	32 050	22 525	8 310	917	257	41
Insurance	3 972	1 412	1 591	455	372	142
Taxes:						
R & P	47 000	21 197	14 307	2 425	3 736	5 335
Excise & Sales	25 923	13 181	12 458	284	-	-
Franchise, Misc	14 024	5 742	5 415	1 026	1 137	704
Income	9 540	3 471	4 045	704	921	399
Total Taxes*	96 487	43 591	36 225	4 439	5 794	6 438
General Expense	112 644	55 286	38 312	5 252	5 490	8 304
Total Expenses	518 407	241 170	176 297	33 757	33 128	34 055

*Power System Taxes shown above

CLASS IV

ALLOCATION OF INVESTMENT TO THE VARIOUS CLASSES OF SERVICE

Account	Total Investment	Residential	Small Lgt. and Power	Large Lgt. and Power	Misc. Municipal	Street Lighting
Power System						
Plant	$ 573 000	$ 240 895	$ 226 000	$ 55 082	$ 39 078	$ 11 945
Fuel in Storage	4 579	1 703	1 288	828	607	153
Trans Lines	319 467	135 003	125 000	30 869	21 901	6 694
Trans Subs	86 638	36 539	34 000	8 362	5 941	1 796
Gen Invest (Pwr Sys)	15 138	7 178	4 779	1 651	1 172	358
Total Power System	998 822	421 318	391 067	96 792	68 699	20 946
Distribution System						
Subs	377 175	192 415	135 000	33 526	6 058	10 176
Poles and Lines:						
Cust.	907 000	630 728	252 600	3 356	20 316	-
Primary	175 239	79 908	62 000	13 903	(1 578	-
					(17 850	-
St Ltg	88 061	-	-	-	-	88 061
Transf and Devices:						
Cust.	71 092	49 437	19 799	264	1 592	-
Demand	159 878	83 556	58 300	14 537	(1 650	-
					(1 835	-
Meters	207 136	90 262	99 157	9 655	8 062	-
Services	160 851	88 200	61 331	7 060	4 260	-
St Ltg Equip	55 059	-	-	-	-	55 059
	2 201 491	1 214 506	688 187	82 301	63 201	153 296
Gen Invest (Distb)	233 571	130 408	71 122	8 823	6 783	16 435
Total Distb	2 435 062	1 344 914	759 309	91 124	69 984	169 731
Total Investment	3 433 884	1 766 232	1 150 376	187 916	138 683	190 677

CLASS IV

ALLOCATION OF EXPENSES TO THE VARIOUS CLASSES OF SERVICE

Account	Total Expense	Resi-dential	Small Lgt. and Power	Large Lgt. and Power	Misc. Munic.	Street Lighting
Power System						
Fixed	$ 16 917	$ 7 134	$ 6 640	$ 1 632	$ 1 158	$ 353
Variable	11 087	4 130	3 120	2 001	1 465	371
Taxes	4 321	2 054	1 362	470	334	101
Trans Lines	4 941	2 083	1 940	477	339	102
" Subs	3 476	1 464	1 367	335	238	72
" Taxes	3 325	1 580	1 048	362	257	78
	11 742	5 127	4 355	1 174	834	252
General	7 073	3 316	2 153	823	593	188
Total Pwr Sys	51 140	21 761	17 630	6 100	4 384	1 265
Distb and Utilization						
Substation	16 101	7 255	5 600	1 683	1 178	385
Lines	25 449	15 571	6 700	379	869	1 930
Meters	13 664	5 958	6 538	637	531	-
Transf	5 777	3 329	1 950	371	127	-
Services	3 321	1 820	1 267	146	88	-
Installation	12 146	5 296	5 812	566	472	-
St Ltg Util.	4 235	-	-	-	-	4 235
Total	80 693	39 229	27 867	3 782	3 265	6 550
Commercial	31 787	21 926	8 780	118	706	257
Uncollectible	2 548	575	476	94	1 363	40
New Business	20 342	14 420	5 104	465	259	94
Insurance	1 692	830	529	165	114	54
Taxes:						
R & P	39 100	21 783	11 945	1 478	1 138	2 756
Excise & Sales	13 280	7 504	5 625	151	-	-
Franchise, Misc	7 096	3 275	2 448	544	567	262
Income	3 128	984	1 197	410	473	64
Total Taxes*	62 604	33 546	21 215	2 583	2 178	3 082
General Expense	81 219	41 802	29 208	2 830	3 615	3 764
Total Expenses	332 025	174 089	110 809	16 137	15 884	15 106

*Power System Taxes shown above

Reconciliation of Investment Value Used in
Cost of Service Study With Value Shown in Annual Report
For Year Ended December 31

Plant, Property, Rights, etc.	$ 67,752,538
Add Materials and Supplies (at cost)	978,587
Transportation reserve	105,738
Leased Property	229,084
	69,065,947
Deduct: Noble Street Equipment	746,193
Value Used in Study	$ 68,319,754

Reconciliation of Expenses Used in
Cost of Service Study With Value Shown in Annual Report
For Year Ended December 31

Operating Expense, Maintenance and Taxes	$ 6,044,969
Deduct (Net interchange purchases)	56,640
Add (uncollectible)	35,942
Adjustment	1
Value Used in Study	$ 6,024,272

INTERPRETATION OF RESULTS

It can not be too strongly emphasized that any interpretation of the results of this study in comparing costs between companies, or between different parts of the same company and classes of service must recognize the differences in source of power, voltages, customer densities, system designs, competitive service, load characteristics, economic conditions affecting particular classes of business and the general economic and political structure of the territory served. While it is true that studies of this nature may indicate unusual results for particular classes of service in the particular year, especially where unusual business conditions affected the class of service being studied, studies of this nature made over a period of several years or for several succeeding years, will yield reasonably reliable, accurate and consistent results. In classes of service composed of a large group of customers the operating characteristics of a few customers will have little effect on the total load.

In comparing the results of the cost study for the several classes of service, obviously certain classes of service yield a return above the average returns from all the business of the company, while other classes of business yield a return which is below the average of 7.65% for the system. For instance, the resale business indicates a return of 10.28 per cent on the investment devoted to this service, while the cotton gin business indicates a loss of about $45,000 a year in net or 2.93%. If each class of business is served at rates that will pay the direct cost served by such business and in addition contribute something to a proportion of the general

costs, the resulting improved utilization of facilities and better economy will accrue to all classes of business. In the design of rates it is essential that the gross return must be adequate to support the entire business, that unjust discriminations shall be avoided and that competition, public policy and practical necessities shall be considered. It must be realized, however, that every form of discrimination is not necessarily unjust discrimination. Not only must rate schedules be competitive with other forms of service but for certain business it is essential that they be promotional in character in securing new business and in stimulating greater usage of electricity by existing customers.

The petroleum industry constituting as it does the major industrial load of the company naturally is of considerable importance in comparing the results of the rates of return for the several classes of business. The oil field business, together with the refineries, yields over 18 per cent of the total net earnings of the company, before provision for retirement. The composite net return of these two classes of business amounts to $949,510 per year or more than 8.1 per cent on the investment assignable to this class of business. The comparatively low rate of return of 5.49 per cent shown for refinery business is due primarily to the fact that during the year studied a portion of the refinery load was lost to competitive service, though this particular loss of business was not of sufficient magnitude to produce a marked difference in the results of the study. However, under normal conditions of business, the rate of return indicated for the refineries would be somewhat greater than shown in

this study. It is characteristic of both of these classes of business that the load is of unusually high annual load factor. For instance, the oil field results in an annual load factor of 74.6 per cent, while the refineries resulted in a load factor of 53.2 per cent.

The grain and milling business, another major industrial load of the company, showed a return of 9.2 per cent before provision for retirement. This business likewise has a relatively good load factor of 53 per cent.

The rural business indicates the relatively low rate of return of 6.3 per cent before provision for retirement, due to the fact that the customer density is quite low, being approximately three customers per mile of rural line. The cost of rural service is very largely determined by factors which are nearly independent of the energy usage of the customers such as investment in distribution lines.

The high cost of service to the cotton gin business per kilowatthour is due primarily to the extremely poor annual load factor of 2.49 per cent and to the rather high special investment involved. These factors, together with the low annual revenue, resulted in a loss of $45,017.00. However, the cotton crop for the particular year studied was only 50 per cent of normal and it is, therefore, reasonable to believe that these results are somewhat worse than in years of greater cotton production.

The coal business likewise has a poor annual load factor of 13.6 per cent and resulted in a return of only 5.3 per cent before provision for retirement.

The return on the total business in the Eastern

district was 6.36 per cent. No detailed study of the return by classes of service has been made for this particular district because of the great difficulty involved in obtaining the distribution investment values classified as desired, as an actual field valuation would be necessary.

It is of particular interest to compare the results for the several classes of service; namely, the residential, the small light and power, the large light and power, miscellaneous municipal and the street lighting within the various rate class towns. The total return before provision for retirement in Class I towns was 9.47 per cent; in Class II towns was 8.64 per cent; in Class III towns was 7.41 per cent and in Class IV towns was 3.63 per cent. These results are of particular significance when the sales per customer for the several classes of service are compared in the various class towns, especially as we know that one promising manner of reducing costs is by increasing loads. The low over all return indicated from business in Class IV towns may be attributable to several factors. Not only is the average customer's usage relatively low in these towns for the several classes of service but the customer density is also unusually low in these towns. The distribution systems in these classes of towns were nearly all constructed during the period of high construction cost and, too, there are 136 Class IV towns and this large number of relatively small substations, particularly when served from high voltage lines, inherently results in a large investment per unit of capacity.

The street lighting service yields a low rate of return in all classes of towns, varying from a low of 0.94

per cent in Class IV towns to a high of 3.35 per cent in Class I towns. In comparing the cost for this class of service with the rate of return shown for other classes of business, it is important to bear in mind that the company not only supplies electric service to the street lighting business at a great many locations, but also maintains and operates the utilization equipment and in case of the overhead street lighting system the company also owns the utilization facilities. Not only does the cost of the overhead street lighting facilities represent a large special investment, but there is also a large investment in poles, fixtures, lines and substation equipment which provides service only to the street lighting business. Other facilities of the company, such as investments in power plants, transmission lines, substations and distribution systems serve many customers in various classes of business, such as residential, commercial, etc. This joint use of these facilities being highly desirable to promote economy in both investment and operating expenses. In the case of street lighting service, not only is a proportionate share of joint facilities and expenses required, but also the special investment in poles, lines, substations and fixtures and the utilization expenses are necessary. Therefore, the low rate of return shown for this class of service is due primarily to the large investment required for service, particularly the special investment in utilization equipment which other classes of customers furnish themselves.

The miscellaneous municipal class of service apparently is earning a reasonably good return in all classes of towns. The unusually high rate of return shown for this class of

business in Class IV towns is undoubtedly due to the very small proportion of water pumping service which is supplied in these towns, as the rate for lighting service only is somewhat higher.

The rate of return of the large light and power service which includes customers having demands above 10 kw and consumption above 20,000 kwhrs per year varies from 10.9 per cent in Class I towns to 7.65 per cent in Class III towns. These results indicate that the company is in a particularly favorable position to meet competition for this business.

The rate of return from the small light and power business varied from 11.29 per cent in Class II towns to a low of 4.08 per cent in Class IV towns and the average kwhr sales for customers varied from 746 in Class IV towns to 7040 in Class I towns.

The residential class of service showed a return of 9.51 per cent in Class I towns and the return in Class IV towns was only 2.06 per cent, before provision for retirement, and the kwhr sales per customer per year varied from 400 in Class IV towns to 751 in Class I towns.

It is interesting to note that in Class II and Class III towns the average consumption for the large light and power customers is relatively low and that the rate of return earned by these two groups is also low. The rate of return earned on the residential and the small light and power customers in Class III and Class IV towns is relatively low as are also the average kwh sales to these groups. These results give some indication of the potential market in these towns and particularly so as many of the small towns are without

gas service. Undoubtedly, however, the income of the residential customers is also comparatively low in these small towns.

It is of interest to note that after giving the full benefit of diversity to all classes of service and after a proportionate allocation of general system investments the total power system per unit of demand amounts to $299.00 per kw for the various classes of service. For the particular year for which this analysis was made, there very obviously was a considerable excess plant capacity available. As the loads increase there will be a more efficient utilization of the power system investment with consequent lower unit investment assignments to any one class of service and improved operating efficiency will also result with increasing loads, all of which will contribute to reduced costs for all of the classes of service.

An examination of the summarized load characteristics of the several classes of service on page 47 reveals that a low annual load factor for a class of service does not necessarily indicate a high intra-class diversity. For instance, the cotton gins with a load factor of 2.49 per cent have a diversity of 1.09 and the coalfields with a load factor of 13.6 per cent have a diversity of 1.3 while the grain and milling business with the relatively high load factor of 53 per cent has a diversity of 1.32.

In making the demand allocations to the several classes of service in Class IV towns, an arithmetical error was made in the demand for the small light and power business. Corrections have been made in the results where the error was as much as 1 per cent in either investment, expense or earnings values.

This correction, however, has resulted in the use of an expense value which is $3,841 greater than the control figure of $6,024,272 and the use of an investment value which is $135,065 greater than the control figure of $68,319,754. The correction of this minor error throughout the entire work would have involved much re-typing and due to the minuteness of the error in the final results it was not believed to be justified.

As costs constitute a major element in the design of electric rates it is of particular interest to determine the relative magnitudes of the various components of cost for several of the classes of service. By assuming a value of 8 per cent to provide for interest and depreciation on the investment and by adding the operating and maintenance costs, Chart VII has been designed to portray graphically these relative components of cost for several of the classes of service in Rate Class I. Referring to Chart VII it will be noted that of the total cost of service for the residential customers, 48.3 per cent is a fixed quantity, 49.1 per cent is dependent upon the class load demand, and only 2.6 per cent is dependent upon kwhr, or energy, sold. Of the total costs of supplying the large light and power service, 17.7 per cent is a fixed quantity, 74.17 per cent is dependent upon the class load demand, and 8.13 per cent a function of the energy sold. For the small light and power class of service, 15.9 per cent of the total cost is fixed, 78.2 per cent is a function of class load demand, and 5.9 per cent varying with the energy sold. In a manner similar to this, it is thus possible to determine the major components of cost for all classes of service. It is thus evident that "demand costs" constitute the larger

portion of the total cost of electric service and these costs are dependent upon the size of the generating plant, substations and distribution system which the magnitude of the consumer's demand necessitates. It is significant that the demand portion of costs is of far greater magnitude for the light and power customers than is the case with the residential customers.

With a satisfactory method established of making the cost analysis, it is necessary to make subsequent studies of this nature as often as the prevailing balance between classes of service is materially disturbed.

RELATIVE ELEMENTS OF COSTS IN CLASS RATES

RATE CLASS I

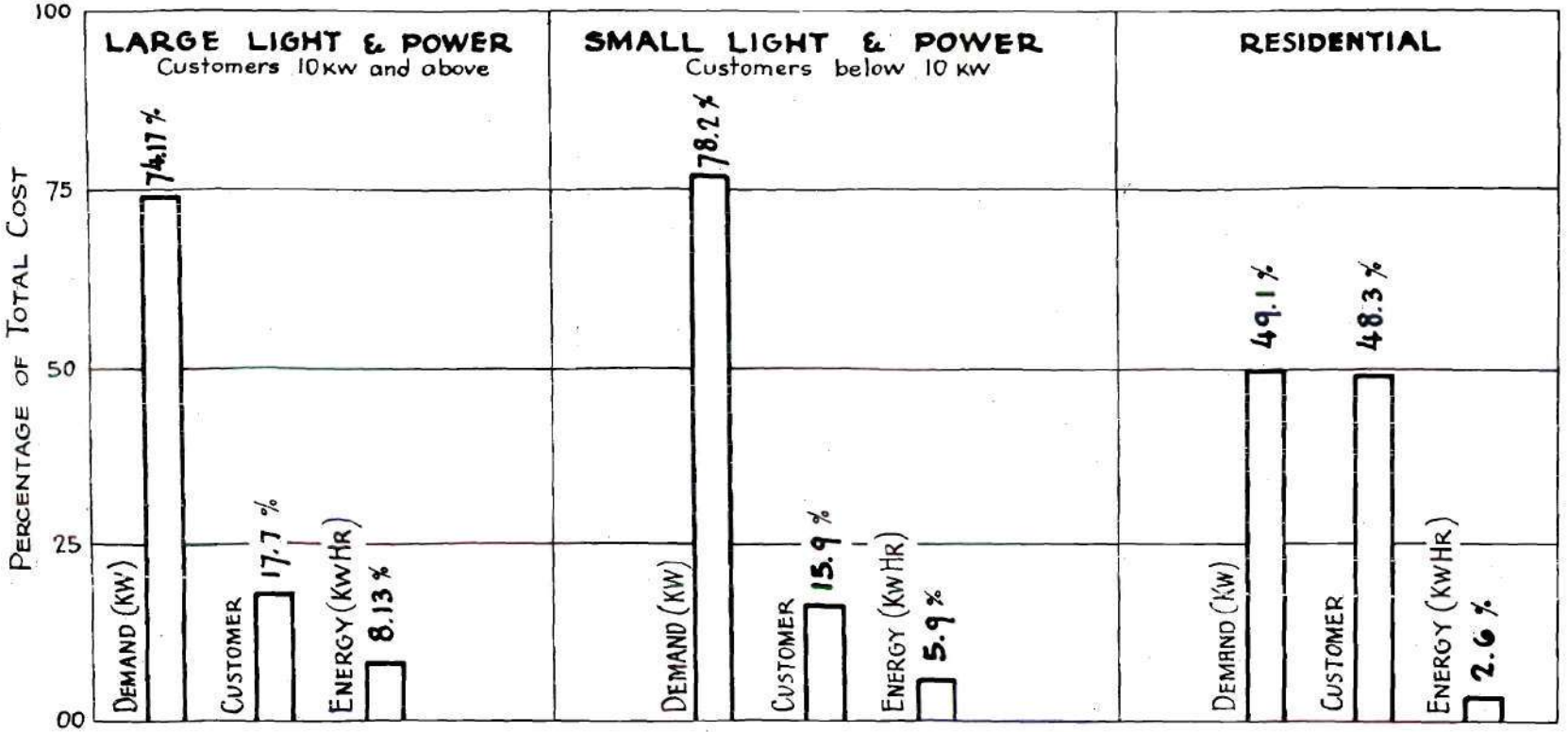


CHART VII

APPENDIX

LOAD CHARACTERISTICS - REFINERIES

Load demand charts were available for 51% of the total refinery sales and complete billing records were, of course, available for all of the refinery business. By a study of the billing records for each month of the year, it was obvious that the annual peak diversified demand of the refineries occurred either in the month of February or in October, the sales and the Kw loads in all other months being much less, thus obviating the necessity of studying all of the demand charts for the entire year, in order to determine the annual simultaneous peak demand and further inspection of the demand charts eliminated Sundays and all night hours.

The values of the remaining demand charts were converted to actual Kw and tabulated for each day and hour; these demand values were then added for all of the refineries being studied in order to determine the actual simultaneous peak demand for the year. (Efforts were made to photostat the original demand charts for reproduction in this report, but the wax charts were too faint for satisfactory results.) The transcribed values of Kw demands on the annual peak day for the refineries studied are tabulated below, however.

REFINERY LOAD DEMANDS

February 12th

Hr. of Day	#1	#2	#3	#4	Total
12	840	720	187	1700	3447
1	910	720	187	1670	3487
2	910	720	194	1700	3524
3	860	720	194	1700	3474
4	815	720	187	1730	3452
5	770	720	187	1730	3407
6	815	720	180	1700	3415
7	910	720	216	1670	3516
8	865	920	216	1700	3701
9	1010	1010	187	1730	3937
10	1030	1010	180	1790	4010
11	1100	1220	166	1790	4276
12 (noon)	1084	1440	180	1730	4434
1	913	720	137	1670	3440
2	840	780	137	1760	3517
3	1080	780	137	1730	3727
4	816	720	144	1790	3470
5	770	720	144	1730	3364
6	790	720	144	1700	3354
7	910	720	173	1700	3503
8	865	720	144	1700	3429
9	890	720	144	1700	3454
10	910	720	144	1700	3474
11	910	720	144	1670	3444
12	815	720	144	1700	3379

It will be noted that the simultaneous peak demand occurred at 12:00 noon on February 12th and amounted to 4434 Kw at the transmission substation. During the year the energy sales to these four refineries were 20,658,700 kwhr, thus resulting in an annual load factor of 53.2%. The annual sales to the entire refinery business were 40,760,168 kwhrs and the annual peak diversified demand of the refinery industry was therefore 8750 Kw, which is the value used in the study. In a manner similar to this the annual peak demands of the other industrial classes of service were determined.

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